William Forster

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FORSTER'S
Arithmetick.

EXPLAINING

The Grounds and Principles of that Art, both in Whole Numbers and Fractions:

By such Plain, Easie and Familiar Rules and Precepts, that any Person, of a reasonable Capacity, may (in a short time) attain to a competent Proficiency therein, without the help of any Tutor.

By *WILLIAM FORSTER.*

LONDON,
Printed for *George Sambridge*, and are to be sold at his House on *Clarkenwell-Green.* 1667.

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TO ALL

Merchants, Factors,

Accomptants and others, desirous of knowledge in the Useful ART of

ARITHMETICK.

THis *Treatise I here present to your View, is Principally intended for the Instruction of them, who are desirous attaining a perfection of knowledge in the Art of* Arithmetick: *The chief Scope and design hereof being to lay down the whole Rules of the said Art, in so plain and easie a Method, that any one of a reasonable Capacity may soon comprehend them: And all who have not the convenience of a Master or Tutor, may hereby alone attain a competent perfection therein, without the Aid or Assistance of any to instruct them. The Method observed in the Composure is a gradual proceeding Step by Step, and from Rule to*

Rule, as they ought to be read and practised, beginning with Numeration, *in which there are more then ordinary Tables fitted for the true and easie numbering of many Figures together*—Addition, *that is furnished with Examples both of* Coyn, Weights, Measures, *and* Time, *&c. and so is Substraction also*—Multiplication *is as in others, onely here and there are necessary Compendiums added*—*And in* Division, (*which is the most difficult of all the Species*) *there are different wayes of working that Rule; so that any person may use that which he best apprehendeth or liketh.*

Having finished these four Primary, or (*indeed*) *fundamental parts of* Arithmetick, *I proceed next to* Reduction, *where* (*as in* Addition) *there are Examples also of* Money, Weights, Measures, *and* Time, *and from thence to the* Golden-Rule of Three Numbers, *both* Direct *and* Retrograde; *all hitherto being performed in* Whole Numbers.

After this I proceed to Fractions, *beginning with* Numeration, Multiplication, Division, Reduction, Addition *and* Substraction. *The reason of which Method is, because* Fractions *may be Multiplyed and Divided without* Reducing, *but they cannot be*

be Added or Substracted but they must first be reduced.

The Ordinary general and most useful Rules, *being hitherto explained both in* Whole Numbers *and* Fractions, *I proceed to those of more particular concern to* Merchants, Factors, Tradesmen, *and the like, and such are* Rules of Practice, The Double Rule of Three, Company *or* Fellowship *with or without* Time, Exchange, Barter, Alligation, *and the like. All which, every Rule in the directions thereunto belonging do sufficiently explain and demonstrate.*

Lastly, The Course and Method being observed, the young Practitioner may in a short time attain to such a competent proficiency in this Art of Vulgar Arithmetick, so far forth as to make him capable of any employment in way of Trade, or Merchandise, for such I write it, and to such I recommend it, wishing them good success in all their honest Endeavours and Practices, and so I bid them

Farewell.

OF ARITHMETICK.

ARITHMETICK is the Art of Numbring well, to the attaining whereof belongeth the knowledge of *Figures*, which are in number nine, to which is added an [o] which makes ten. Of which nine Figures, and the [o] (called a Cypher) all other Numbers, how great soever, are compounded.

Of *Numbers* there are three sorts.

1. *Digit Numbers*, which are all Numbers under Ten.

2. *Article Numbers*, which are all numbers that consist of any one *Digit number* and a Cypher, as *Ten*, *Twenty*, *Thirty*, &c.

3. *Compound Numbers*, which are any number of Figures alone, or with Cyphers and Figures mixed together, as *Seven hundred eighty four*, which consists of three Digit Numbers put together, or *Three hundred and seven*, which consists of two Digits and a Cypher intermixed.

Having declared unto you what Number

is, I will now shew you the Characters and places of the Nine Figures and the Cypher before mentioned, which is the office of *Numeration*, which is the first part, or rather, the first step to *Arithmetick*.

CHAP. I.

Of NUMERATION.

NUMERATION is that part of Arithmetick which teacheth how to read any summe of Figures that is written down, or to write down any summe that shall be desired: to the attaining whereof, it is necessary first to know the Names and Characters of the Figures, which are as followeth,

One	Two	Three	Four	Five	Six	Seven
1	2	3	4	5	6	7

Eight	Nine	Cypher.
8	9	0

And here note, that the Cypher it self signifieth nothing, but being adjoyned with any other Figure or Figures, it augmenteth or mileth up the place of that Figure or Figures ten times; or if there be added two

Cyphers,

Cyphers, it augmenteth the Figure or Figures an hundred times, as the Figure 2 standing alone, signifieth only *two*, and is so called; but if to it you adjoyn a Cypher thus 20, it maketh the *two* ten times two, that is, *twenty*, and must be so called: But again, if to the forementioned *two* you adjoyn two Cyphers thus, 200, it augmenteth the *two* an hundred times, that is, it maketh it *two hundred*, and must be so called.

Note, That what is here said of the figure *two*, is to be understood of any other figure, as the following Table plainly expresseth.

First place, or place of unites.	Second place, or place of tens.	Third place, or place of hundreds.
1 one	10 ten	100 one hundred
2 two	20 twenty	200 two hundred
3 three	30 thirty	300 three hundred
4 four	40 forty	400 four hundred
5 five	50 fifty	500 five hundred
6 six	60 sixty	600 six hundred
7 seven	70 seventy	700 seven hundred
8 eight	80 eighty	800 eight hundred
9 nine	90 ninety	900 nine hundred

By this Table you may plainly see that the Figure of 1 standing alone in the first place, or place of unites, signifieth barely One, and 2 Two, and 3 Three. But 1 standing in the second

second place, or place of Tens, signifieth Ten, and 2 Twenty, and 3 Thirty. And *one*, *two*, or *three* standing in the third place, or place of Hundreds, signifieth 100 One Hundred, 200 two Hundred, 300 three Hundred, *&c.*

Again, if to *one*, *two*, or *three*, you adde three Cyphers, we call that the fourth place, or place of thousands, and we in that place call one, two. or three, 1000 one thousand, 2000 two thousand, 3000 three thousand, & so on to what number of places you please.

So, the fifth place is the place of ten thousands. The sixth place is the place of hundred thousands. The seventh place is the place of millions. The eighth place is the place of ten millions. And the 9th place is the place of an hundred millions, as in the following Table.

Numbers.	Places.
1 one	1
10 ten	2
100 an hundred	3
1000 a thousand	4
10000 ten thousand	5
100000 an hundred thousand	6
1000000 a million	7
10000000 ten millions	8
100000000 an hundred millions	9

Having

Having given you the names and places of the nine Figures, and how they are augmented by the continual adding of Cyphes, I will now shew you how to read any great summe that shall be written down.

Let it be required to read this number of Figures, 763587254. for the ready doing whereof, make a prick with your pen between every third figure, beginning at the right hand, as is here done, 763. 587. 254. these pricks divide the great number into smaller numbers, namely into 763. 587. and 254. Now the first three Figures towards the left hand, namely, 763, stand in the place of Millions, and must be called 763 millions. The second three Figures, namely, 587, stand in the place of thousands, and must be called 587 thousand. The three Figures which stand next the right hand, stand in the place of hundreds, and must be called 254, two hundred fifty four. And the whole number together is thus to be read, Seven hundred sixty three millions, five hundred eighty seven thousand, two hundred fifty four.

And

And by this distinction may any great Summe be easily read, an example whereof you have in this following Table.

3	Three
27	Twenty seven
304	Three hundred and four
3.461	Three thousand, four hundred sixty one
40.572	Forty thousand, five hundred seventy two
358.206	Three hundred fifty eight thousand, two hundred and six
6.982.471	6 millions, 982 thousand, four hundred seventy one
98.423.175	98 millions, 423 thousand, one hundred seventy five
736.528.379	Seven hundred thirty six millions, five hundred twenty eight thousand, three hundred seventy nine

CHAP.

CHAP. II.

Of ADDITION.

ADDITION is the collecting or gathering together of divers ſmaller ſummes into one entire or groſs ſumme.

For the performance whereof, *Let the ſeveral ſmaller ſums be ſet in order one under another, and underneath them draw a line, then beginning with the lowermoſt figure of the laſt rank (which is that next your right hand) adde all the figures in that rank together, then conſidering how many Tens the addition of that rank contains, and for every Ten keep one Unite in mind to be carried to the next rank of figures, and what odd Digits there are above the Tens, ſet down under that rank beneath the line. Having finiſhed one rank of numbers, proceed to the ſecond, and from that to the third, &c.*

EXAMPLE.

Paid at ſeveral times to ſeveral perſons, theſe ſummes following.

	lib.	
To Mr. *Green*	937	*Apr.* 7. 1654.
To Mr. *Ward*	772	*Apr.* 16.
To Mr. *Smith*	53	*May* 4.

Set

Set the ſeveral ſums in order as you ſee in the Example, and draw a line under them, then beginning with the laſt rank of Figures, which is that towards the right hand, begin with the lowermoſt Figure thereof, which is 3, ſaying, 2 and 2 is 5, and 7 is 12, ſet 2 under the line, and carry one Unite to the next rank of Figures (becauſe there was one Ten in the addition of that rank) ſaying, One as I carried and 5 is 6, and 7 is 13, and 3 is 16, ſet 6 under line, and carry one Unite to the next rank, ſaying in your mind, One which I carried and 7 is 8, and 9 is 17, ſet 7 under the line, and carry one to the next rank, but ſeeing there are no more ranks to carry your Unite to, therefore you muſt ſet it down, and your ſumme will ſtand as here you ſee, The total or groſſe ſumme whereof being 1762 l. And in this manner may you adde as many or as few ſummes together as ſhall be required, as by the Examples following may appear, which I have onely ſet down for young beginners to practice by.

To Mr. Green	937
To Mr. Ward	772
To Mr. Smith	53
	1762

Crowns	Yards of Cloth	Barrels of Sope	Tuns of Wine
6250	579	5002	57
4621	364	469	84
872	851	200	36
60	963	69	23
	26	83	
In all 11803	24		200
Crowns	8	5824	Tuns.
		Barrels	

In all 2805 Yards of Cloth.

Addition of Numbers of divers denominations.

By numbers of divers denominations is meant such numbers as consist of themselves and their parts, as if the summes be of money, then the greatest denomination is of Pounds, and the parts of a Pound are Shillings, and the parts of a Shilling are Pence, and the parts of a Penny are Farthings, which is the smallest of English money.

Now to perform the worke of addition of Numbers of divers denominations this order is to be observed.

Place all numbers of the same denomina-

tion

tion one directly under another, as pounds under pounds, shillings under shillings, pence under pence, and farthings under farthings. Then draw a line under them, and begin your Addition with the least denomination first, observing how many times the next greater denomination is contained in the least, and for every time carry one unite to the next denomination (as before you did the tens) setting down the remainder, if any be, then adding the next denomination together, take notice how many times the next greater denomination is contained in that lesser, carrying for every time one to the next denomination greater; thus proceeding till you have gone over all the denominations, be they never so many.

Example 1. Let the numbers to be added be 29 *li.* 16 *s.* 8 *d.* 32 *li.* 17 *s.* 9 *d.* 81 *li.* 13 *s.* 11 *d.* and let it be required to find the total or gross summe.

Here in this Example

	li.	*s.*	*d.*
the least denomination	29	16	8.
I gence, therefore I	32	17	9
begin with them, and	81	13	11
say 11 *d.* and 9 *d.* is			
20 *d.* which is 1 *s.* and	144	48	28
8 *d.* make a prick against			

the 9, and say 8 *d.* and 8 *d.* is 16 *d.* that is

1 *s.*

1 s. 4 d. make a prick against the 8, and set down the odd 4 d. then (because there are two pricks in the line of pence) you must carry 2 s. to the place of shillings, saying 2 s. which I carry and 13 s. is 15 s. and 17 s. is 32 s. which is 1 l. 12 s. make a prick against 17, and say 12 s. and 16 s. is 28 s. make a prick against the 16, and (because there is no more numbers to be added) set down the odd 8 s. under shillings, and (being there is two pricks in the line of shillings) carry 2 to the place of pounds, saying 2 and 1 is 3, and 2 is 5, and 9 is 14, set down 4, and carry 1 to the next line, and say 1 and 8 is 9, and 3 is 12, and 2 is 14, which (because it is the last) you must set down, so is the total or gross summe 144 l. 8 s. 4 d.

Example 2. Let the numbers to be added together be 37 li. 16 s. 9 d. 3 q. 21 l. 9 s. 8 li. 1 q. 13 li. 12 s. 9 d. 2 q. Place the numbers as in the margine, draw a line under them, and begin with the least denomination (which in this Example is farthings) first, saying, 2 q. and 1 q. is 3 q. and 3 q. is 6 q. which one penny and

li.	s.	d.	q.
37	16	9	3
21	09	8	1
13	12	9	2
72	19	3	2

2 q.

2 q. remaining, which 2 q. I place under the line, and carry the one peny to the next row which is the place of pence, saying, one peny and 9 d. is 10 d. and 8 d. is 18 d. which is 1 s. and 6 d. [*Now against the 8. I make a prick with my pen for my better remembrance, to signifie that there is one shilling to be carried to the place of shillings*] then go on and say 6 d. and 9 d. is 15 d. which is 1 s. 3 d. therefore against 9 I make a prick with my pen, and (because this is the last number) I set down the odde 3 d. under the place of pence, and (because I find two pricks in the line of pence, therefore) I carry 2 s. to the place of shillings, saying, 2 s. which I carried, and 1 s. is 14 s. and 9 s. is 23 s. which is one pound and 3 s. remaining, I make a prick against 9. and going on, say 3 s. and 16 s. is 19 s. which (being there is no more numbers to be added, and being also lesse then 20 s.) I set under the line, and finding one prick in the line of shillings, I therefore carry one to the place of pounds, saying, one which I carried and 3 is 4, and 1 is 5, and 7 is 12, set down the 2 under the line (as in addition of numbers of one denomination) and carry 1 to the next row, saying, one that I carried and 1 is 2, and 2 is 4, and 3 is 7, which

being

being the laſt I ſet down, and ſo the total or groſs ſumme is 72 *li.* 19 *s.* 3 *d.* 2 *q.*

Some other Examples ready wrought, for learners to practice by.

l.	*s.*	*d.*	*l.*	*s.*	*d.*	*q.*
365	13	9.	63	13.	4.	1
721	06.	3	52	13.	9	3
200	00	10	61	15	2.	2.
69	13	4	9	11	9	3
1356	13	4	187	04	2	1

Thus much for *Addition of Engliſh Money*, which order is alſo to be obſerved in the addition of other money of other Countreys, ſo that there is no difference, if you do but know how many of the ſmaller denominations make one of the next greater. And what hath been here ſaid of *Money*, is likewiſe to be underſtood of *Weights, Meaſures, Time*, &c. Examples of all which here follow. And firſt of

Addition of Troy Weight.

The moſt uſual Commodities weighed by this kind of weight, are *Gold, Silver, Pearl,*

and

and Troy: and the several denominations of this weight are *Pounds*, *Ounces*, *Penny-weights* and *Grains*, whereof a *Grain* is the least; of which,

24 Grains make one Penny-weight.
20 Penny-weights make one Ounce,
and
12 Ounces make one Pound.

Now in the addition of this kind of Weight, you must at every 24 grains make a prick, and for every prick carry so many penny weights to the place of penny weights [because 24 grains make one peny-weight.] Again, at every 20 penny weight make a prick, and for every prick carry so many ounces to the place of ounces, [because 20 penny-weights make one ounce.] Lastly, at every 12 ounces make a prick, and for every prick carry so many pounds to the place of pounds, [because 12 ounces make 1 pound] as by examples following will appear.

Example. Let the numbers to be added together be 7 *li.* 11 *ou.* 13 *pw.* 19 *gr.* 6 *li.* 7 *ou.* 16 *pw.* 19 *gr.* 3 *li.* 7 *ou.* 9 *pw.* 6 *gr.* Place your numbers as in addition of money, each under other according to their respective denominations

li.	*ou.*	*pw.*	*gr.*
7	11.	13	19
6	07.	16.	19.
3	07	09	06
18	02	19	20

nominations as in the margine, then draw a line under them, and begin your addition with the leaſt denomination firſt, *viz.* Grains, ſaying, 6 *gr.* and 19 *gr.* is 25 *gr.* which is one penny-weight and one grain, make a prick againſt 19. and carry the odde grain to the number above, ſaying, 1 *gr.* and 19 *gr.* is 20 *gr.* which (becauſe it is leſs then one penny weight) I ſet under the line, then finding one prick in the line of grains, I (therefore) carry one to the place of penny-weights, ſaying, 1 and 9 is 10, and 16 is 26, which is one ounce, and 6 *pw.* make a prick againſt 16, and ſay 6 and 13 is 19, which (being leſs then an ounce) ſet under the line; then for the one prick, carry 1 to the place of ounces, ſaying, 1 and 7 is 8, and 7 is 15, which is one pound and 3 ounces, make a prick at 7, and ſay 3 and 11 is 14, which is one pound and 2 ounces, ſet down the 2 ounces, and for the two pricks carry 2 pounds to the place of pounds, ſaying, 2 and 3 is 5, and 6 is 11, and 7 is 18, which ſet under the place of pounds, ſo is your addition ended, and the ſumme is 18 *li.* 2 *on.* 19 *pw.* 20 *gr.*

Other

Other Examples for practice.

li.	ou.	pw.	gr.	li.	ou.	pw.	gr.
32	9.	12	16	0	10	17.	11
17	11.	6	9.	0	6.	0	5
34	8.	15.	10	0	0	16	8.
8	10	4	7	0	5	2	19
94	3	18	18	1	10	16	19

Addition of Avoirdupois little weight.

The Commodities weighed by this kind of weight are such as are garbleable, as *Ginger*, *Cloves*, *Mace*, *Pepper*, *Cinamon*, &c. and the several denominations of this weight are *Pounds*, *Ounces*, and *Drachms*, of which

16 Drachms make one Ounce, and

16 Ounces make one Pound.

therefore prick at every 16 drachms, and for every prick carry so many ounces to the place of ounces. Again, prick at every 16 ounces, and for every prick carry so many pounds to the place of pounds, as by the examples following appeareth.

Examples

Examples of Addition of Avoirdupois little weight.

li.	*on.*	*dr.*	*li.*	*on.*	*dr.*
121	11	09	96	13	07
76	05	12	05	09	12
32	10	00	06	03	09
91	07	13	10	00	00
32	13	07	05	07	09
246	00	09	34	02	05

Addition of Avoirdupois great weight.

By this weight are weighed all commodities that are sold by the Hundred (the Hundred-weight containing 112 pound) as *Butter, Cheese, Wooll, Flax, Corans*, &c. and the several denominations of this weight are Hundreds, Quarters, Pounds and Ounces, of which

16 ounces make one pound.

28 pound makes a quarter of an hundred.

4 quarters makes an hundred weight, *viz.* 112 pound.

wherefore, for every 16 ounces carry one pound, for every 28 pounds carry one quarter, and for every 4 quarters carry an hundred

hundred weight, as in the Examples following.

C.	q.	l.	ou.
632	3.	16.	12.
761	2	07	03
499	3.	12	09
1894	1	08	08

C.	q.	l.	ou.
35	1	09	111
21	3.	02.	00
16	2	14	12
73	3	10	07

Addition of Cloth measure.

By this measure is commonly measured *Linnen* and *Woollen Cloth*, and all kind of *Stuffs*, *Silks*, *Satins*, *Velvets*, &c. and the several denominations of this measure are *Ells*, *Yards*, *Quarters*, and *Nails*, which

4 Nails make one quarter of a yard.

4 quarters make one yard, and

5 quarters of a yard make an ell.

Therefore, for every 4 nails carry one quarter, and for every 4 quarters carry one yard.

But for Ells, for every 5 nails carry one quarter, and for every 5 quarters carry one ell, as in these Examples.

Yards	qu.	nails	Ells	qu.	nails
325	2	3.	631	3	3.
65	1	2.	25	1.	2
31	3.	1	16	3	4.
65	3.	2	31	2.	3
488	3	0	705	3	0

Addition of Dry measure.

By this measure is measured *Salt*, *Coals*, and *Corn*, &c, and the common denominations are *Bushels*, *Pecks*, and *Pints*, of which

16 Pints make one Peck, and
4 Pecks one Bushel.

Wherefore, for every 16 pints carry one peck, and for every 4 pecks carry one bushel, as in the Examples following.

Bush.	Peck.	Pint.	Bush.	Peck.	Pint.
276	3	9	161	3.	13.
162	0	4	91	2	12.
630	3.	12	64	3.	11
1069	3	09	318	2	04

Addition of Wine measure.

The denominations of Wine measure are *Tunn*, *Hogsheads*, *Gallons*, *Pottles*, *Quarts*, *Pints*, of which

2 Pints make one quart.
2 Quarts one pottle.
2 Pottles one gallon.
63 Gallons one hogshead.
4 Hogsheads one Tun.

Therefore for every 2 pints carry one quart.
For every 2 quarts one pottle.
For every 2 pottles one gallon.
For every 63 gallons, one Hogshead, and
For every 4 Hogsheads, one Tun.
as in the Example.

Tun	*hogsh.*	*gal.*	*pottle*	*quart*	*pints.*
632	3	60.	1	0	1.
269	2.	40	0	1.	0
672	1	16	1.	0	1
1574	3	54	1	0	0

Addition

Addition of Long measure.

By which is measured any *Distance*, as from one place to another, or the *height* of any Building, or the *length* of any Gallery, or of any piece of *Timber*, or Mast of a Ship, *&c.* The usual denominations whereof are *Yards*, *Feet* and *Inches*, of which

12 Inches make one foot, and
3 Foot one yard.

Therefore, for every 12 inches carry one foot, and for every 3 foot carry one yard, as in these Examples:

Yards	*feet*	*inches.*	*Yards*	*feet*	*inches.*
3261	2	9.	325	1	11.
376	1.	0	96	2.	3.
127	2	10	64	0	10
3766	0	07	486	0	00

Addition of Time.

Time is measured by *Years*, *Dayes*, *Hours* and *Minutes*, of which

60 Minutes make one hour.
24 Hours one day, and
365 dayes one year.

Wherefore, for every 60 minutes carry one hour, for every 24 hours carry one day, and for every 365 dayes carry one year, as in the examples following.

years	*dayes*	*hours*	*minutes.*
5670	200	16.	30
654	345.	20.	45.
276	16	11	24.
69	54	23.	52
6670	250	00	31

Let this suffice for the practice of Addition, next for the proof thereof.

The Proof of Addition.

Having placed your numbers in order, and added them together, and set the Total under the line, *Cut off the upper number by drawing a line with your Pen betwixt that and the others, then add all the numbers together except the uppermost, and set the Total of them under the Total before found, then add this last Total, and the first number which you cut off with your pen together, and if the sum of those two numbers be equal with*

your

your total sum first found, then is your work right; otherwise not.

Example. In the first Example of whole numbers, the sums to be added were 937, 772, and 53, these numbers placed in due order and added together, the total or gross summe of them is 1762; now to prove whether this Total be true or not, I cut off the uppermost number (to wit 937) with a dash of the pen, and I adde the other two numbers together, namely, 772, and 53, and the total of them is 825, which number being added to 937, (the number cut off) the sum of them is 1762, exactly agreeing with the Total first found, and proves the addition was truly performed; But if they had disagreed, then the work had been erroneous. The like course must be taken for the proof of those summes which have different denominations; as in Money and Weight, as by the Examples following will appear.

Another Example.

	7822
	5609
	376
	8547
first Total	22564
last Total	14532
Proof	22364

Other Examples proved.

1 Exam. of Money.	li.	s.	d.	q.
	37	16	9	3
	21	9	8	1
	13	12	9	2
1 Total	72	19	3	2
2 Total	35	2	5	3
Proof	72	19	3	2

2 Exa. of Troy weight.	li.	ou.	pw.	gr.
	32	9	12	16
	17	11	6	9
	34	8	15	10
	8	10	4	7
	94	3	18	18
	61	6	6	2
	94	3	18	18

CHAP. III.

Of SUBSTRACTION.

AS by the adding of two or more numbers together, there was produced another number which was equal to all the other numbers, and was called the sum or total of them. So Substraction teacheth the contrary, namely, by having one or more small sums to be taken out of one greater summe

sum, it sheweth what part of the greater sum is left behind when such substraction is made, which part so left behind is called the *Remainder.*

And as in Addition the sums to be added may be either of the same denomination, or of different, so also may they be in Substraction, and the manner of placing them is the same, that is, *unites* under *unites*, *tens* under *tens*, &c. placing alwayes the greater number uppermost, as by examples following will appear.

1. *Substraction of numbers of one denomination.*

Example 1. Let it be required to substract 2976 out of 96527, *place the numbers one under another as in Addition, and draw a line under them, and beginning with the first figure towards your left hand, say*

6 out of 7, and there remains 1, place 1 under the line, and proceed to the next figure, saying 7 out of 21 cannot (*wherefore you must alwayes add* 10 *to the number above, which in this example is* 2, *and it makes* 12,) therefore take 7 out of 12, and there remains 5, place 5 under the line, and (*because you added* 10 *to the* 2 *to make it* 12, *you must*)

96527	
2976	
93551	

carry a unite to the next figure, ſaying, one which I carried and 9 is 10, take 10 out of 5, which I cannot, therefore I muſt adde 10 to 5, and it makes 15, and ſay 10 out of 15, and there remains 5, place 5 under the line, and (*becauſe you added* 10 *to* 5 *to make it* 15, *you muſt therefore*) carry a unite to the next figure, ſaying, one which I carried and 2 is 3, take 3 out of 6 and there remains 3, place 3 under the line, and becauſe there is no more figures to be ſubſtracted from the the number above, you muſt ſay, nothing from 9 and there remains 9, ſet the 9 under the line, and your ſubſtraction is ended.

Other Example.

Out of 9635 quarters of Wheat
Take 964 quarters

Remains 8671 quarters.

Bought 2106 hogſheads of Wine

Sold at ſeveral times 120, 235, 94 } hogſheads

Sold in all 449 hogſheads

Remains 1657 hogſheads unſold.

Subſtra-

Subſtraction of Numbers of divers denominations.

In ſubſtraction of Numbers of divers denominations, you muſt obſerve the ſame order as in Addition, namely, to place every number in due order, with reſpect to its denomination, as pounds under pounds, ſhillings under ſhillings, &c. the greater number always uppermoſt, and drawing a line under them, begin with the leaſt denomination firſt, ſubſtracting it from the line above, and ſetting the remainder under the line as in whole numbers, but if the pence or ſhillings in the upper row be ſmaller then thoſe in the neather row, you muſt adde 12 d. or 20 s. to the ſmaller number, that ſo ſubſtraction may be made, as by examples following will appear.

Example. Let it be required to ſubſtract 2628 li. 16 s. 10 d. out of 9320 li. 10 s. 7 d. place the numbers in order, and beginning with the pence, ſay 10 d. out of 7 I cannot (therefore I muſt adde 12 d. (which is one ſhilling) to 7 d, and it makes 19 d.) but 10 d. out of 19 d.

	li.	s.	d.
Lent	9320	10.	07
Paid	2628	16	10
Reſts	6691	13	9

19 d. and there remains 9 d. set the 9 d. under the line, and (because I added 12 d. to 7 d.) I must therefore carry one to the place of shillings, saying, 1 s. which I carried, and 16 s. is 17 s. then 17 s. from 10 s. I cannot take, therefore I must adde 20 s. (which is one pound) to 10 s. it makes 30 s. and 17 s. out of 30 s. and there remains 13. set 13 under the line, and carry one to the place of pounds, saying, one which I carried and 8 is 9 take 9 out of 01 cannot, but 9 out of 10 and there remains one, set 1 under the line, and carry a unite to the next place, saying, one which I carried and 2 is 3, take 3 out of 21 cannot, but 3 out of 12, and there remains 9, place 9 under the line, and carry one to the next place, saying 1 which I carried and 6 is 7, take 7 out of 3 I cannot, but 7 out of 13, and there remains 6, place 6 under the line, and carry one to the next row, saying 1 and 2 is 3, take 3 from 9 and there remains 6, place 6 under the line, so is your Substraction ended, and the remainder is 6691 li. 13 s. 9 d.

Example 3. Suppose a man had lent to another man 1000 pound, and that the borrower had paid thereof at one time 127 li. at another time 430 li. 10 s. and at a third payment 50 li. and the creditor would know

how

how much he hath received, and how much is owing of his debtor.

	li.	*s.*	*d.*
Money lent	1000	00	00
	127	00	00
paid at seve-	430	10	00
ral times	50	00	00
paid in all	607	10	00
rests to pay	392	10	00

Place the numbers as here you see, first the sum of money lent, and draw a line under it, then set the sums paid at several times one under another, and draw a line under them: Then adde all the sums which have been paid at several times together, which make 607 li. 10 s. which is the sum which the debtor hath paid in all, then substract this 607 li. 10 s. from 1000 li. and there will remain 392 li. 10 s. and so much is still owing to the Creditor.

Example in Troy-weight.

	Oun.	pw.	gr.	
Received	635	16	12	of Plate.
Returned	467	13	7	of Plate.
Remains	168	03	05	

Example in Avoirdupois great weight.

	C.	gr.	li.	on.	
Bought	621	3	20	10	of Cheese.
	12	0	6	4	
ſold at	9	3	12	1	
ſeveral	16	2	9	7	
times	32	3	11	12	
ſold in all	61	1	11	8	
unſold	560	2	9	2	

The Proof of Subſtraction.

The Proof of Subſtraction is performed by Addition, for adding the number to be ſubſtracted, to the remainder, the ſum of them muſt be equal to the number given, if you have

have truly wrought. As in the example of numbers of one denomination,

the number given is	96527
the number to be substracted is	2976
the remainder is	93551
Proof	96527

CHAP. IV.

Of MULTIPLICATION.

MULTIPLICATION is no other then a Compendium of Addition, neither doth it perform any thing that may not be done thereby, only Multiplication performeth that at one working, which to perform by Addition would require many, as if you would know how much 26 times 8 is, it would be tedious to set down 26 eight times and then to adde them together, which when you had done, you should find the sum to be 208, this I say to perform by Addition would be tedious, but by Multiplication very expeditious and easie, as will appear.

Before you enter upon the practice of *Multiplication*, it is necessary to have in remembrance perfectly the product produced

by the Multiplication of any one of the nine Digits, by any other of the same, as readily to know, that 4 times 5 is 20, 6 times 7 is 42, 2 times 9 is 18. 7 times 9 is 63, 8 times 9 is 72. &c. Which this Table following will plainly declare, and must be perfectly learned by heart before you attempt to multiply great numbers.

The Table of Multiplication.

1	2	3	4	5	6	7	8	9
2	4	6	8	10	12	14	16	18
3	6	9	12	15	18	21	24	27
4	8	12	16	20	24	28	32	36
5	10	15	20	25	30	35	40	45
6	12	18	24	30	36	42	48	54
7	14	21	28	35	42	49	56	63
8	16	24	32	40	48	56	64	72
9	18	27	36	45	54	63	72	81

The use of the Table of Multiplication, and the manner how to read it.

The use of this Table is to finde the sum or product of any digit multiplied by it self, or

or of any two digits multiplied one by the other, as if you would multiply 8 by 8, look in the square of the Table where the two lines from 8 in the side of the Table, and 8 in the top of the Table do meet, and in that square you shall finde 64, and so much is the sum or product of 8 multiplied by 8.

Again, if you would multiply 6 by 8 look in the side of the Table for 6, and in the top of the Table for 8, and in that square where 6 in the side and 8 in the top do meet, you shall finde 48, and so much is the sum or product of 6 multiplied by 8, or of 8 multiplied by 6, which is all one, for 6 times 8, and 8 times 6 is one and the same.

So in the Table, if you finde 8 in the side of the Table and 6 in the top, in that square where those two lines meet, you shall also finde 48, as before.

And so for any other two digits, as 7 times 8 is 56, 4 times 9 is 36, 8 times 5 is 40, and so of any other two digits.

In *Multiplication* three things or terms are to be considered, namely:

The *Multiplicand*,
The *Multiplier*, and
The *Product*.

The *Multiplicand* is the number to be multiplied.

The

The *Multiplier* is the number by which the *Multiplicand* is multiplied, and

The *Product* is the number which is produced by the multiplication of the *Multiplicand* and the *Multiplier* together.

Thus, if it were required to multiply 8 by 7, here 8 is the *Multiplicand*, 7 the *Multiplier*, and 56 is the *Product*, for 8 times 7, or 7 times 8, is 56.

In *Multiplication* it mattereth not which of the two numbers given is made the *Multiplicand*, or which the *Multiplier*, for the *Product* produced by either will be the same, but the usual and best way is to make the greater number the *Multiplicand*, and the lesser number the *Multiplier*, except one of the numbers have one or many cyphers on the right hand thereof, as these and such like numbers, 700, 230, 9000, in such like numbers it will be best to make the greater number the *Multiplier*, and the lesser number the *Multiplicand*.

To perform the work of *Multiplication*, this is

THE RULE.

The numbers to be multiplied must be set one under another, viz. *the* Multiplicand (*or greater*

greater number) above, and the Multiplier *(or lesser number) below, the last figure of the* Multiplier *under the last figure of the* Multiplicand, *then draw a line under them, and (having learned the foregoing Table perfectly by heart) multiply every digit of the* Multiplier, *into every digit of the* Multiplicand, *setting the severall Products under the line, then having finished your Multiplication, draw a line, and add all the Products together, & the sum of those Products is the generall Product of the whole Multiplication, as by the following examples will appear.*

Example 1. Let it be required to multiply 736 by 7, that is, let it be required to know how many dayes there are in 736 weeks; First, I write down 736 the Multiplicand, and under it 7, the Multiplier, and under them I draw a line, then I multiply 7 into every digit of the Multiplicand, saying, 7 times 6 is 42, place 2 under the line under 7, and for the four tens keep 4 in mind, then say again, 7 times 3 is 21, and 4 which I kept in mind is 25, place 5 under the line, and keep the

Weeks	
736	Multiplicand
7	Multiplier
5152	Product
dayes	

two tens in mind, then say again, 7 times 7 is 49, and two which I kept in mind is 51, place 1 under the line, the 5 tens (because there is no more figures to be multiplied) I set down under the line also, so is the work ended, and the product of this multiplication is 5152, and so many dayes there are in 736 weeks.

Example 2. Let it be required to multiply 2417 by 5, as if it were demanded, How many shillings are there in 3417 Crowns? Place the numbers under one another, and draw a line under them as in the Example, then begin your Multiplication, saying, 5 times 7 is 35, place 5 under the line, and keep the three tens in mind, then say again, 5 times 1 is 5, and 3 which I kept in mind is 8, place 8 under the line, and

Crowns	3417	Multiplicand
	5	Multiplier
Shillings	17085	Product

(because it is losse then 10, I keep nothing in mind) then say again, 5 times 4 is 20, place the cypher 0 under the line and keep the two tens in mind; lastly, say 5 times 3 is 15, and 2 which I kept in mind is 17, which 17 being

being the last number I place under the line and so my Multiplication is ended, and the product is 17085, and so many shillings are there in 3417 Crowns.

Example 3. In the two foregoing Examples, the Multiplier consisted but of one digit, we will now shew how Multiplication is performed when the Multiplier consists of more then one figure, therefore in this Example, let it be required to multiply 5704 by 37, as if 5704 poor men were to have 37 shillings a man, how many shillings a man, must there be to pay them? Place your numbers and draw a line under them as you see in the Example, then begin your multiplication in this manner, saying, 7 times 4 is 28, set 8 under the line, and keep the two tens in mind, then say 7 times nothing is nothing, but the two tens in mind is 2, set 2 under the line, then say 7 times 7 is 49, set 9 under the line, and keep 4 in mind, then lastly, say 7 times 5 is 35, and 4 in mind is 39, which being the last number to be multiplied I set down under

5704	Multiplicand
37	Multiplier
39928	
17112	
211048	Product

der the line, so is the multiplication of one of the digits (namely 7) finished.

Then begin to multiply the second digit, saying 3 times 4 is 12, place 2 in the second line one place towards the left hand, and keep 1 in mind, then say three times nothing is nothing, but 1 in mind is 1, set down 1 by the 2 in the second line, thirdly, say 3 times 7 is 21, place 1 in the second line, and keep the two tens in mind; Lastly, say 3 times 5 is 15, and 2 in mind is 17, which 17 (because there is no more figures to be multiplied) I place in the second line also.

Having thus done, I draw a line under them, and add these two lines together, as in common Addition or numbers of one denomination, saying 8 is 8, place 8 under the line, then say 2 and 2 is 4, place 4 under the line, then say 1 and 9 is 10, place a cypher under the line, and carry 1 to the next place saying 1 and 1 is 2, and 9 is 11, place 1 under the line, and carry 1 to the next row, saying 1 and 7 is 8, and 3 is 11, place 1 under the line, and carry 1 to the next place, saying 1 which I carry and 1 is 2, place 2 under the line, and so is your multiplication ended, and the Product is 211048. And so many shillings must be provided to pay 5704 poor men 37 shillings a piece.

Example

Example 4. Let it be required to multiply 57325 by 4032, place the multiplicand and multiplier one under another, and draw a line as before, then proceed to the multiplication as formerly, saying, first, 2 times 5 is 10, set down a cypher & keep 1 in mind, then 2 times 2 is 4, & 1 in mind is 5, place 5 under the line, then 2 times 3 is 6, set 6 under the line;

57325	Multiplicand
4032	Multiplier
114650	
171975	
2293000	
231134400	Product

then 2 times 7 is 14 set down 4, and keep 1 in mind, then 2 times 5 is 10, and 1 in mind is 11, which 11 (being the last) I set down. The multiplication of one of the digits being finished, proceed to the multiplication of the next, saying 3 times 5 is 15, set down 5 in the second line one place more towards the left hand, and keep 1, then 3 times 2 is 6, and 1 kept is 7, set down 7, then 3 times 3 is 9, set down 9, then 3 times 7 is 21, set down 1 and keep 2 in mind, then 3 times 5 is 15, and 2 in mind is 17, which being the last set down also.

Two of the figures of the multiplier being finished

finished proceed to the third, which (in this example) being a cypher, you may wholly neglect, and proceed to the multiplication of the fourth figure, only remember to remove the product of the fourth figure one place more to the left hand, as in the example you may see, for the cypher, which is in the Multiplier, I set a cypher under 7, for a cypher must keep his place, and the figures following must be removed a place farther.

Then for the multiplication of the fourth and last digit, say 4 times 5 is 20, set down a cypher (under 9) and keep 2 in mind, then 4 times 2 is 8, and 2 in mind is 10, set down a cypher and keep 1 in mind, then 4 times 3 is 12, and 1 is 13, set down 3 and keep 1, then 4 times 7 is 28, and 1 kept is 29, set down 9 and keep 2, then 4 times 5 is 20, and 2 kept is 22, which 22 (because the multiplication is ended) set down also.

Having thus multiplied all the digits severally, draw a line under their products, and add them all together as in the former example, so shall you finde their general product to be 231134400.

Other Examples for Practice.

40326	73580
5432	50032
80652	147160
120978	220740
161304	36790000
201630	
219050832	3681354560

Three brief Notes or Compendiums, *usefull in Multiplication.*

1. If the Multiplier consist of cyphers in the last place or places, you may omit the multiplication of them, and place the formes figures of the Multiplier under the Multiplicand, thus if it were required to multiply 3257 by 2600 place the numbers as you see in the margine, then multiplying 3257 by

26, the Product will be 84682, to which if you add two cyphers (because there were two cyphers in the Multiplier) it wil bee 8468000, which is the true Product of the Multiplication.

3257
2600
19542
6514
8468200

2. If it be required to multiply any number by 10, 100, 1000, 10000, &c. You have no more to do but to add so many cyphers to the Multiplicand as there are cyphers in the Multiplier, thus if you were to multiply 365 by 10, the Product will be 3650, or by 100, it would be 36500, or by 1000, it would be 365000, or by 10000, it would be 3650000, &c.

3. If any number given were to be multiplied by 5, you may abbreviate your work thus, add a cypher to the Multiplicand, take half that number, and it shall be the Product required, thus if it were required to multiply 8627 by 5, adde a cypher to the multiplicand then it is 86270 the half whereof is 43135, which is the product required.

The Proof of Multiplication.

The most certain proof of Multiplication

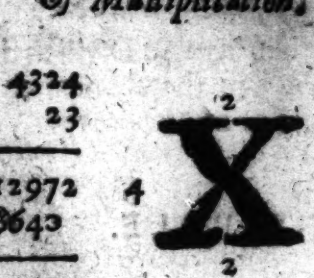
is

is by Diviſion, but becauſe Diviſion is not yet taught, I will here ſhew a neer way by which Multiplication may be proved. Which is thus,

THE RULE.

Make a Croſſe as in the Margine, then, any ſums being multiplied, you may prove the truth of your work in this manner, (1) *Caſt away all the nines which you can finde in the Multiplicand, what remaineth ſet on the right ſide of the Croſſe.* (2) *Caſt away alſo the nines in the Multiplier, and what remains ſet on the left ſide of the Croſſe.* (3) *Multiply the figure on the right ſide of the Croſſe by that on the left ſide of the Croſſe, and out of that product caſt away the nines, ſetting the figure remaining over the Croſs, then* (4) *caſt away all the nines in the product, and if the figure remaining be the ſame with that which ſtandeth over the Croſs, then is your Multiplication truly performed, otherwiſe not.*

Example 1. Let it be required to prove the ſum in the Example.



1. Cast away all the nines in the Multiplicand, saying 4 and 3 is 7, and 2 is 9, which being rejected there remains 4, which I set on the right side of the crosse, then

2. Cast away all the nines in the Multiplier, saying 2 and 3 is 5, which (being lesse then 9) I set on the left side of the cross, then

3. Multiply 4 by 5, saying 4 times 5 is 20 from which cast all the nines, and there remains 2, place 2 over the cross, and

4. Cast away all the nines in the Product saying, 2 and 5 is 7, and 4 is 11, cast away 9, and there remains 2, which exactly agrees with the figure over the cross, and demonstrates that the multiplication is truly performed.

Many questions that appertain to the Rule of Three (commonly called the Golden Rule) may be performed by Multiplication only,

only, of which I will give you some Examples.

If 1 day be 24 hours, how many hours are 365 dayes?

```
  365
   24
 ----
 1460
  730
 ----
 8760
```

hours 8760

If 1 li. be 20 sh. how many shillings is 2764 li. ?

```
 2764
   20
 ----
```

shillings 55280

If 1 foot be 12 inches, how many inches in 2760 foot.

```
 2760
   12
 ----
 5520
 2760
 ----
```

inches 33120

If 1 Acre be 160 ſquare Pole,
how many Pole is 3698 Acres?

160

221880
3698

ſquare Poles 591680

Infinite queſtions of this kind might be propoſed, but let theſe ſuffice, and ſo I conclude Multiplication.

CHAP.

CHAP. V.

Of DIVISION.

WHat affinity Multiplication hath to Addition, the ſame hath Diviſion to Subſtraction, for Diviſion may be performed (but with much labor) by Subſtraction, as Multiplication might be by Addition. For Multiplication turns great denominations into ſmaller, and Diviſion turnes ſmaller denominations into greater, as by Examples following will be made appear.

In Diviſion three things are chiefly to be minded, namely.

1. The Dividend, or Number to be divided, which is alwayes the greateſt number of the Three:

2. The *Diviſor*, which is that number by which the Dividend is to be divided.

3. The *Quotient*, which is the number produced by the dividing of the Dividend by the Diviſor, and alwayes conſiſts of ſo many

Unites as the Divisor may be taken out of the Dividend.

To perform Division there are several wayes, but that which is most usually practised in Schools is that which followeth; for the performance whereof, this is

THE RULE.

Place the Divisor *under the* Dividend, *so that the figures next to the left hand stand directly one under the other: having so placed them, try how many times the lower figures are contained in the upper figures, and write that figure which answereth the question within a crooked line in the margine of the work, which is called the* Quotient, *and by that figure multiply the first figure of the* Divisor, *and take the Product out of the figure directly over it, beginning the Substraction toward the left hand; then cancel that figure of the Divisor, and also, that of the Dividend which hath been already made use of, by giving it a light dash with a pen, and write the remain just over the figure cancelled: then proceed to do the like with the second, third, and fourth figure of the Divisor (if there be so many) till having cancelled it all, and then have you finished one work.*

Now

Now if the Dividend have still some figures untouched towards the right hand, then remove the Divisor still toward the right hand, but one place at a time, and then again ask (or try) how many times the lower may be had in the upper, and write the answer in the Quotient whether it be 1 or more, (only it cannot be above 9) and if nothing, then put 0 in the Quotient, then multiply the Divisor by this new figure, and substract the Product, setting the remainer orderly above, as before, this work must be repeated by removing the Divisor still one place towards the right hand, until you come to the last figure of the Divisor, and then the work is finished.

Example 1. Let it be required to divide 4096 by 3. As if 4096 shillings were given to be distributed to several poor people, each person to have 3 shillings, how many persons must there be? Place the numbers as here you see.

```
4096 (1
3
```

Then ask how many times 3 in 4, the quotient is 1, which is put within a crooked line by it self, as here you see.

Then in your mind multiply the Divisor 3 by the quotient 1. And having said these

words, *Once* 3 *is* 3, presently cancel the 3. And having added these words, *Out of* 4, cancel the 4. And after these words, *and there remains* 1, write 1 just over the 4, as you see here done.

```
1
4096 (1
3
```

Then remove the Divisor one place towards the right hand, saying, *how many times* 3 *in* 10, the answer is, 3, write it in the quotient; and in your mind multiply the Divisor 3 by the quotient 3, the product is 9, wherefore say three times three is nine out of ten over head, and there remains one, then (having cancelled the 3 and the 10, write over them 1.

```
11
4096 (13
33
```

Again, remove the Divisor 3 one place more, asking *how many times* 3 *in* 19? the answer being 6, write 6 in the quotient, and say 6 times 3 is 18 out of 19, and there remains 1, wherefore having cancelled the 3, and the 19, write 1 over 9, and remove the Divisor once more.

```
111
4096 (136
333
```

and

and ask *how many times* ? *in* 16 ? answer is 5, which write in the quotient, then in mind say 5 times 3 is 15 out of 16, and there remains 1, and cancelling the 16 and the 3, write 1 over 6. Now because the Divisor 3 is advanced so far till it is come to stand under 6 in the Dividend, which 6 is the last figure there, the Divisor cannot be removed any more, and therefore the Division is ended, and the quotient being 1365, shews that the Divisor 3 is contained in the Dividend 4096, 1365 times; and 1 remaining, which 1 being lesse then the Divisor 3. doth not contain it once, but one third part of once, which sheweth ther must be 1365 persons, and then there will be one shilling over. The proof of Division is by multiplying the quotient into the Divisor, and to the product add the remain; then if the work be wel done, the sum shall be equall to the Dividend.

xxx 1
4096 (1365
3333

So 1365 the quotient multiplied by 3 produceth 4095, to which adding the remain 1; the summ 4096 is equall to the Dividend, which proveth the work to be true.

Here we devided onely by one figure, whereof we will take another Example, to make the work easie and clear, and to be a

fair introduction to the multiplying by more figures then one.

Example 2. Suppose the same 4096 were to have been divided by 8, that is, every poor person were to have 8 shillings, how many persons must there then be?

The work must have stood thus, namely; the 8 must not have stood under the 4, as the 3 did in the former Example, but under the 0, because 8 is greater then 4, and cannot therefore be taken out of it, therefore you must see how many times 8 you can have in 40, which you may have 5 times, set 5 in the quotient, then how many times 8 in 9, once and 1 remain, set 1 in the quotient, and 1 over 9, then how many times 8 in 16 twice, set 2 in the quotient and there remains nothing, so the quotient is 512 (which is one place lesse) and so many poor persons must there be, and no shillings remaining.

```
   1
4096 (512
 888
```

Example 3. Let it be required to divide 1310720 by 4096, as if one vessel of Wine should contain 4096 Pints, how many such vessels would 1310720 pints fill?

Place

1310720 (
4096

Place your numbers as here you see, and ask how many times 4096 is there in 13107? to find an answer to this question immediately, to a learner would be hard, let him therefore ask how many times 4 can he have in 13, which he can readily do, and say three times, then put 3 in the quotient, and say 3 times 4 is 12, which substract out of 13 over it, saying 2 out of 3, and there remains 1, and 1 out of 1 & there remains 0, cancelling the 4 and 13, and set the remain 1 over the 4, as you see.

```
   1
1839
13107 20(3
4096
```

Then go on saying 3 times 0 is 0, out of 11, and remains still 11, again. 3 times 9 is 27, take 7 out of 10 there remains 3, to be set over the 0, which is over 9, and 2 with 1 borrowed (to make the 0 10, from the which the 7 was taken) is 3, and 3 out of 11, remains 8, which write over the place of 0 in the Divisor, cancelling the 9 in it, and also those figures of the Dividend 110 out of which you have taken any thing; lastly, say 3 times 6 is 18, take 8 out of 7 I cannot, therefore

therefore (borrowing 10) say 8 out of 17 remains 9, which write over the 7, then in the next place, the 10 borrowed is 1, and the 10 in the 18 is 1. Say therefore 1 and 1 is 2, out of 3, and the remain is 1, which write over the 3, having still cancelled the figures which you have used orderly as you go.

Now the whole Divisor being cancelled, it must be removed on one place further, and placed as here.

Then ask how many times 4096 in 8192? it will be found (because of the 0 after the 4) as often as 4 in 8, that is 2 times,

```
      0 0
      1 1
  0 1 8 3 9 0
  1 3 1 0 7 2 0 (320
    4 0 9 6 6 6
      4 0 9 9
        4 0
```

put therefore in the quotient 2, and work as before, saying 2 times 4 is 8, out of 8 remains 0, then 2 times 0 is 0, out of 1 remains 1, then 2 times 9 is 18, take 8 out of 9 remains 1, (which put over the 9) and 1 out of 1 in the next place remains 0, then lastly, 2 times 6 is 12, that is 2 out of 2 there remains 0, and 1 out of 1, there also remains 0, cancell and put the remainder over as formerly.

Now again, the Divisor being all cancelled,

led, ſhould be removed; and ask how many times 4096 in 0000, the anſwer is 0, which being put in the quotient, the work is done.

And the quotient 320, ſhews that the Diviſor 4096 is contained in the Dividend 1310720, three hundred and twenty times, and ſo many veſſels, each of which contains 4096 pints, will 1310720 pints fill.

And whether the Diviſor have 2, 3, 5, 7, or more places, the working is ſtill like this, not differing from it at all.

Brief wayes or Compendiums in Diviſion.

As in Multiplication, ſo in Diviſion there are brief Rules, as if the Diviſor have one or more cyphers towards the right hand, thoſe cyphers may be placed orderly under the laſt figure or figures of the Dividend, and remain there till the work be done, which will much ſhorten it.

As if 2587645 were to be divided by 15000, place them thus, 2587645 (
15 000

And say how many times 15 in 25? answer is 1, which write in the quotient, and multiply in mind the divisor by the quotient,

```
 0 0
 3 1
1 0 3 7
2 5 8 7 6 4 5 (172
1 5 5 5 0 0 0
 1 1
```

saying once one is one, out of 2 there remains 1, then cancel the 2, and the 1 under it, and write the remaining 1 over it, as here is done then say once 5 is 5 out of 5, and there remains 0, therefore cancel the two fives, and over the uppermost write 0.

Now remove the divisor one place, and ask how many times 15 in 108? answer is 7, which write in the quotient, and multiply, saying 7 times 1 is 7, out of 10 remains 3, which write over the 0, then say 7 times 5 is 35, take 5 out of 8 remains 3, which write over 8, and 3 out of 3 remains 0.

Now again, remove the divisor, and ask how many times 15 in 37? answer is 2, which write in the quotient, and say 2 times 15 is 30, out of 37 remains 7, and the Division is ended, the remain being 7645.

Proof

Proof of this.

Multiply the quotient	172
by the Divisor	15
	860
	172
The Product	2580
Before which put the three cyphers, and then it is	2580000
To which add the remain	7645
The total is	2587645

Which is equal to the Dividend, and therefore the work is right.

So if one would divide any sum by 10, 100 1000, 10000, *&c.* he need but cut off the first, two first, three first, or four first figures towards the right hand, the other figures shall be the quotient, and those cut off the remain.

As if 1587645 be divided by 1000, the quotient is 1587, and the remain 645.

As many questions appertaining to the *Rule of Three* may be performed by *Multiplication* only, so may divers be by *Division* only, but all in general of that Rule by *Multiplication* and *Division* jointly, as when we come

come to that Rule will appear. In the mean time I would give you only four, which shall be just the converse of those I gave you in *Multiplication.*

If 365 dayes be 8760 hours, how many hours in one day?

```
  2
 14
 252
 8760   (24 hours
 3655
  36
```

If 55280 shillings be 2764 pounds, how many shillings is in one pound?

```
 11
 55280   (20 shillings
 27644
 276
```

If 2760 foot be 33120 inches, how many inches is one foot?

x
3x
x650
33x20 (12 inches.
2760
276

If 3698 Acres contain 591680 square Perches, how many Perches are in one Acre?

45
x14
2328
591680 (160 Perches.
36988
3699
36

Another way of Division, which is more easie than the former, and without cancelling any figure, and is proved by Addition.

THere is another kind of Division which is very much used, and is in most request with those who have most occasion to divide great numbers, the manner of working it is not much difficult, for one or

two

two examples will make it plain.

Example 1. Let it be required to divide 162483 by 1321, set down your numbers as you see them placed in the margine, *viz.* First, set down 162483 the Dividend, then on the left hand thereof set the Divisor 1321 with a crooked line between them, then on the right hand thereof make another crooked line which must serve to set the figures of the quotient in, so are your numbers placed in due order, then draw a line under the Dividend, and make a prick under the figure 4, because so far the figures of the Divisor would extend if they had been placed underneath the Dividend, according as in the other Examples, this prick serves only to shew how far you have proceeded in your work, and must at every Division be removed a place further, till at length you come to the last figure of the Dividend: your numbers being thus placed with a line under them, you are ready for the work, which must be performed according to the directions of the following Rule.

1321) 162483 (

THE

THE RULE.

Demand how often the Divisor may be had in the Dividend, and place that number in the quotient, then multiply the Divisor by the quotient, and place the product under the line: then substract this product from the Dividend and set the remainder under the product, then make a prick under the next figure of the Dividend, and bring that figure down to the remainder, and then proceed as before.

Example, Your numbers being placed as is before directed, you may begin your work in this manner, first, say how many times 1321 can I have in 1624, say once, place 1 in the quotient, by which 1 multiply the Divisor 1321, beginning at the left hand, saying, once one is 1, place 1 under the line, then once 2 is 2, set 2 under the line, then once 3 is 3, place

1321) 162483 (123
1321
3038
2642
3963
3963
0000

3

3 under the line, lastly, once 1 is 1, place 1 under the line, then substract this 1321, from 1624 and there will remain 303, to this 303 bring down the next figure in the Dividend, namely 8, so will that number be 3038, under which draw a line, and repeat the same work again, saying, how many times 1321 can I have in 3038, which may be had 2 times, place 2 in the quotient, by which 2 multiply the Divisor 1321, saying 2 times 1 is 2, place 2 under the line, then 2 times 2 is 4, place 4 under the line, then 2 times 3 is 6, place 6 under the line, lastly, 2 times 1 is 2, place 2 under the line, and substract this 2642 from 3038, and there will remain 396 to this 396 bring down the next figure of the Dividend, which is 3, so is this number made 3963, under which draw a line, and repeat the work once again, saying, how many times 1321 can I have in 3963, which may be had 3 times, by which 3 multiply the Divisor 1321 saying 3 times 1 is 3, then 3 times 2 is 6, then 3 times 3 is 9, and lastly, 3 times 1 is 3, which place under the line, and substract it from the line above, which in this example is the same number, therefore there remains nothing, and the work is ended, but if any remainder had been, that should have been set under the line, as by the examples following will make appear.

Another

Another Example for Practice.

5624) 793058 (141

5624
23065
22496
5698
5624
74 remains

In this Example where 793058 is divided by 5624, you may perceive that the quotient is 141, and 74 remaining.

The Proof of this Division.

This kind of Division is proved by Addition, for, *If you add the several Products arising from the Multiplication of the several quotients into the Divisor, and also add thereunto the remainder (if any be) the total of this Addition shal be equal to the Dividend, if there be no error in the work.*

So in the Example following, if you add

add 4325 the first Product, and 30275.

```
4325) 76321 (17
      ..
      ------
1 Product 4325
          53071
          -----
2 Product 30275
           2796 remain
          -----
          76321 Proof.
```

the second Product, and 2796 the remainder together, in the same order as they now stand in the example, you shall finde the totall of this Addition to be 76321, equal to the Dividend, which demonstrates the work to be true. And thus much concerning Division.

CHAP.

CHAP. VI.

Of *REDUCTION.*

REDUCTION cannot properly be termed any real Rule of Arithmetick, but rather the Application, Use, or Proof of Multiplication and Division, but those that have written of it (as many do not mind it) do give it this definition.

To Reduce is to convert or change any number from one denomination to another, as sometimes from lesser to greater, and sometimes from greater to lesser.

By which, Coins, Weights, and Measures may be reduced from one denomination to another, as from their greater terms to lesser and from their lesser to their greater.

By this Rule you may reduce the Coins, Weights and Measures of one Countrey, into the Coins, Weights and Measures of another Countrey. For the working or performing whereof, this is,

A general Rule.

Any greater denomination is turned into

a lesser by *Multiplication*, and any lesser denomination is turned into a greater by *Division*.

1. To bring therefore a greater denomination into a lesser, you must first consider how many of the lesser make one of the greater, and by that number you must alwayes multiply.

2. To bring a lesser denomination into a greater, you must consider how many of the lesser make one of the greater, and by that number you must alwayes divide.

The denominations of English money are Pounds, Shillings, Pence, and Farthings, of which four farthings make one peny, 12 pence one shilling, and 20 shillings make one pound, therefore,

To bring { Pounds into Shillings / Shillings into Pence / Pence into Farthings } multiply by { 20 / 12 / 4 }.

To bring { Shillings into Pounds / Pence into Shillings / Farthings into Pence } divide by { 20 / 12 / 4 }

In

These two Questions are the converse of each other, and doe prove each other, and so likewise do all those which follow.

In 567 lib. how many shillings? multiply 567 by 20.

567
20
11340

In 11340 s. how many pounds? divide 11340 by 20.

(567

In 532 lib. 6. s. 5 d. 3 q. how many farthings?

Multiply 532 by 20, it makes 10640, to which add the 6 shillings, it is 10646 shillings, that multiplied by 12 makes 127752 to which add the 5 pence, it is 127757 pence, that multiplied by 4, and the 3 farthings added makes 511031.

l.	s.	d.	q.
532	6	5	3

20

10640

6

10646 shillings

12

21292

10646

127752

5

127757 pence

4

511028

3

511031 farthings.

I needed not here have made a line, and set down the 6 odd shillings by it self, neither the 5 odd pence, nor the 3 odd farthings: but have added them in the work with the other figures. As in multiplying 432 by

20,

20, I might have ſaid 2 times 0 is 0, but 6 is 6. Likewiſe in multiplying 10646 by 12, I might have ſaid 2 times 6 is 12 and 5 is 17, ſet down 7 and carry 1. Alſo in multiplying 127757 by 4, I might have ſaid 4 times 7 is 28 and 3 is 31, ſet down 1 and carry 3: then would the work have ſtood as in this Example following.

l.	ſ.	d.	q.
532	6	5	3
20			
10646 ſhillings			
12			
21297			
10646			
127757 pence.			
4			
511031 farthings.			

In 511031 farthings, how many pounds, ſhillings and pence?

Divide 511031 farthings by 4, and it makes 127757 pence and 3 farthings, that divided by 12, it gives 10646 ſhil. and 5 pence, that divided by 20 gives 532. So that in 511031 farthings, there are 532 l.

6 ſ. 5 d. 3 q. as by the work following you may perceive.

xx
xxxxx (39. xxx (5d. (6ſ.
xxxxxx (xxxxxx (xxxxx (532 l.
xxxxxx xxxxxx xxxx
xxxx

I have been the larger in this Example, becauſe I intend more brevity in thoſe which follow.

In 161. 12 ſ. 0 d. 1 q. how many farthings?

l.	ſ.	d.	q.
16.	12	0	1
20			

332 ſhillings
12

664
332

3984 pence
4

15937 farthings.

In 15937 farthings, how many pounds, shillings, pence and farthings?

```
331(1q.  32(0d.  4(1s.
15937 (3984 (33(2 (16l.
4444   1222   220
        11
```

But to reduce shillings into pounds, there is a neerer way, by cutting off the last figure towards your right hand, and taking half the other number which will be pounds, and the figure cut off will be shillings. So 76534 shil. will be 3826 pounds 14 shillings, as by the work appeareth.

```
   1
7653|4
-------
3826 l. 14 s.
```

In halving of any sum, if 1 remains (as here) it signifieth 10 s. and is to be added to the last figure cut off.

Reduction of Troy-Weight.

The denominations of Troy weight are pounds, ounces, penny weights, and grains of which

24 Grains
20 Penny-weight } make { 1 Penny weight
12 Ounces { One Ounce,
{ One pound.

Therefore,

To bring { Pounds into Ounces
{ Ounces into Peny-weight } multiply by { 12
{ Peny weights into grains { 20
{ 24

To bring { Ounces into Pounds
{ Peny-weights into ounce } Divide by { 12
{ Grains into peny weights { 20
{ 24

In 26 pounds, 10 ounces, 12 peny weight 6 grains, how many grains?

l. Oun. p.w. gr.
26 10 12 6
12

52
27

322 Ounces
20

6452 Peny-weights
24

25814
12904

154854 Grains.

In 154854 Grains, how many Pounds, Ounces, Peny-weights and Grains?

l.	Oun.	p.	Gr.
Anſ. 26	10	12	6

Reduction of Avoirdupois Weight.

The denominations of this Weight are Hundreds, Quarters, Pounds and Ounces, of which

16 Ounces } make { One Pound,
28 Pound } make { One Quarter,
4 Quarters } make { One C weight.

Therefore,

To bring { Hundreds into Quarters / Quarters into Pounds / Pounds into Ounces. } multiply by { 4 / 28 / 16 }

To bring { Quarters into Hundreds / Pounds into Quarters / Ounces into Pounds } Divide { 4 / 28 / 16 }

In 5652 hund. 2 quarters, 19 pounds, and 6 ounces Avoirdupois weight, how many ounces?

C.	Q.	l.	Ou.
5652	2	19	6

```
   4
 ------
 22610 Quarters
    28
 ------
 180899
 45220
 ------
 633099 pounds
    16
 ------
 3798600
 633099
 ------
 10129590 Ounces.
```

In 10129590 Ounces, how many hundred, quarters, pounds and ounces?

```
                 1
 21  12          35
 454165(6   6776(1   221(2
 10129590(62309(9(22610(5652
   166666  288888   4444
    11111   2222
```

C

	C.	Q.	L.	Ou.
Anſ.	5652	2	19	6

Reduction of Time.

Time is meaſured by Years, Dayes, Hours and Minutes, whereof

60 minutes } make { one hour,
24 hours } make { one day,
365 dayes } make { one year,

Therefore,

To bring { Years into Dayes } multiply by 365
To bring { Dayes into Hours } multiply by 24
To bring { Hours into Minutes } multiply by 60

To bring { Dayes into Years } Divide by 365
To bring { Hours into Dayes } Divide by 24
To bring { Minutes into Hours } Divide by 60

In 124 years, 236 dayes, 9 hours and 6 minutes, how many minutes?

ye.	da.	ho.	m.
124	236	9	6

365

626

747

374

45496 dayes

24

181993

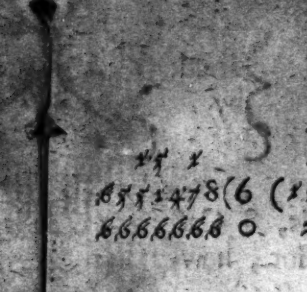
90992

1091913 hours

60

65514786 minutes.

In 65514786 minutes, how many years, dayes, hours and minutes?



Anſ. 124 *ye.* 236 *da.* 9 *ho.* 6 *m.*

Reduction of Wine-Meaſure.

The Denominations of Wine-Meaſure are Tuns, Hogſheads, Galons, Pottles, Quarts and Pints: of which

2 Pints	make one	Quart
2 Quarts		Pottle
2 Pottles		Galon
63 Galons		Hogſhead
4 Hogſheads		Tun.

Therefore,

To bring Tuns into Hogſheads	multiply by	4
Hogſheads into Galons		63
Galons into Pottles		2
Pottles into Quarts		2
Quarts into Pints		2

To bring { Hogsheads into Tuns / Galons into Hogsheads / Pottles into Galons / Quarts into Pottles / Pints into Quarts. } divide by { 4 / 63 / 2 / 2 / 2 }

In 26 Tun, 3 Hogsheads, 8 Galons, 1 Pottle, 1 Quart and 1 Pint, how many Pints?

Tun. hogs. gal. pot. qu. pint.
26 3 8 1 1 1

4

107 Hogsheads

63

329

642

6749 Galons

2

13499 Pottles

2

26999 Quarts

2

53999 Pints

In 53999 pints, how many Tuns, Hogsheads, Galons, &c.

xxxx(1 xx(1
53999 (xB999 (13499
xxxxx xxxxx

x x(1 4x(8 x(3
x3499 (B749 (x87 (26
xxxx B333 44
B6

	Tun.	Hogs.	Gal.	Pot.	Qu.	Pint.
Anſ.	26	3	8	1	1	1

CHAP.

CHAP. VII.

The RULE of THREE *Direct.* Commonly called *The GOLDEN RULE.*

OF all the Rules in Vulgar Arithmetick, this is the chief, though it wholly depends upon the two Rules before taught, *viz. Multiplication*, and *Division*. And of this Rule, the most which follow do participate, for it teacheth that of three numbers being given, to find a fourth, which shall be in proportion to them.

Of this Rule there are two kinds, the one called the *Forward* or *Direct* Rule; the other the *Reverse* or *Backward* Rule of Three, in either of which, three things or Numbers, are given to find a fourth.

To work the forward or direct Rule of Three, these things are to be considered.

First, That the first and third of the numbers given, be both of one denomination or name. As for example: if your first number be *Pounds*, and your third number be *Pounds* also, then they be both of one denomination; but if your first be *Ells* and your third number

ber any thing else but *Ells*, (as *Yards* or the like) then they are of different denominations, but (by *Reduction*) must be brought into one denomination; as if your first number be Ells, and your third number Yards, you must first turn your ells into quarters, and then your yards into quarters also, and then your first and third number will be both quarters, and so of one denomination.

Secondly, That of what name or denomination your second number is, of the same denomination must the fourth number (which is that you seek) be of also; as if the second be *Pounds*, the fourth must be *Pounds* also; if the second be *yards*, the fourth must be *yards* also.

Thirdly, That in this Rule direct you must multiply the second and third terms or numbers together, and the product of them you must divide by the first, the quotient of which division will be the fourth number required, and be of the same denomination with the second number given. To perform which work, this is

THE RULE.

Multiply the second term (or number) by the third, and divide the product by the first; the

the quotient shall be the fourth number desired.

In the working of this Rule, the chief thing is to know how to place the three numbers aright, when they are promiscuously or confusedly given; but by what hath been said already, you may remember that two of them are alwayes of one denomination, as both pounds, or both ells, or both yards or feet, &c. and the other number hath another denomination, and this single denomination is ever the second number in order; and one of the other two, namely, that which hath some relation to this second, is the first; and the other is the third number, whose relation is sought for in the fourth, whence its plain, that the second and fourth are also of the same denomination.

Thus having premised these things, let us now exemplifie the Rule in some Questions.

Question 1.

If 6 yards of cloth cost 8 *lib.* what shall 42 yards cost?

Set the numbers in order as in the example following, If 6 yards cost 8 *lib.* what 42 yards? Here you see that the first number and the third number are both of one denomination

mination, *viz.* both *yards*, and the second number is of another denomination, namely *Pounds*, wherefore the fourth number, which is sought for, must be also *pounds*; therefore multiplying the second number by the third, and dividing the product by the first, the quotient shall answer the question.

First, 42 multiplied by 8, produceth 336, which divided by 6 (the first number) the quotient is 56 *lib.* and so much shall 42 yards cost. Your work being finished, it will stand thus:

Yards		*Pounds*		*Yards*
If 6	cost	8	what	42
				8
		8		336
		336 (56		
		66		

Question 2.

If 2 Ells cost 16 *l.* what are 537 Ells worth?

Place

Place your numbers as here you see; then multiply 537 by 16 (that is, the second number by the third) & the product is 8592.

Ells	lib.	Ells
2	16	537
		16
		3222
		537
		8592

xx
8592 (4296 lib.
xxxx

Which divided by 2 (the first number) the quotient is 4296, which is 4296 l. and so much are 537 ells worth.

Question 3.

If 20 sheep cost 13 pound, 13 shillings 4 pence, what is that a piece?

Turn the shillings and pounds into pence by Reduction thus:

sh.

sh.	*l.*
13	13
12	240
26	520
13	26
156	3120
	156
	4
	3280

Multiply 13 *s.* by 12, the product is 156
And 13 *l.* by 240 (because 240 *d.* make 1 *l.*)
the product is 3120
To which add the 4 *d.* 4

It makes in all 3280

Then the question will be, If 20 sheep cost 3280 *d.* what shall one sheep cost?

	sheep		*pence*		*sheep*
If	20	cost	3280	what	1

		1 *d.*	
1	*d.*	4 (8 *s.*	
3280 (164		164 (13	
2220		222	
		1	

By the rule before delivered, I should multiply

multiply the second number by the third, but in this example, the third number being 1, it doth not multiply; I therefore divide 3280 the second number, by 20 the first number, and the quotient 164, is the price of one sheep in pence, which divided by 12, the quotient is 13 *s.* and 8 *d.* remaining, the price of every single sheep therefore is 13 *s.* 8 *d.*

Question 4.

If 100 *l.* give 6 *l.* Interest for a year, how much shall 750 *l.* give?

Multiply 750 by 6, the product is 4500, which divided by 100, the quotient is 45 *l.* for the thing required.

li.		*li.*	*li.*
If 100	give	6	what 750
			6
			4500

4500 (45 *l.*
400

Question 5.

If 750 *l.* give 45 *l.* interest for a year, what shall 100 *l.* give?

Multiply

Multiply 45 by 100, the product is 4500, which divided by 750, the quotient is 6 l. for the interest of 100 l. for a year.

	li.		li.		li.
If	750	give	45	what	100
			100		
			4500		

3
4500 (6 l.
750
1

Many other questions might be added, but the Rule is so plain that it needs them not; and so general, that he which can resolve one, may aswell resolve any other. However I have here added other Examples for the Learner to practise by.

If 15 Ells of cloth cost 7 l. 10 s. what are 27 ells worth?

Ells

Ells	l.	s.	Ells
45	7	10	27
	20		
	150		
	27		
	1050		
	300		
	4050	13	
		20	1
		4050 (270 s. or	
		13 l. 10 s.	

If 27 ells cost 13 l. 10 s. what will 15 ells cost?

Ells	l.	s.	Ells
27	13	10	15
	20		
	270		
	15		
	1350		
	270		
	4050		

If 27 ells coſt 13 *l.* 10 *ſ.* how many ells ſhall I have for 7 *l.* 10 *ſ.*?

l.	*ſ.*	Ells	*l.*	*ſ.*
13	10	27	7	10
20			20	
270			150	
			27	
			1050	
			300	
			4050	

If I ſell 15 Ells for 17 *l.* 10 *ſ.* how many ells ſhall I ſell for 13 *l.* 10 *ſ.*

l.	s.	Ells	l.	s.
7	10	15	13	10
20			20	
150			270	
			15	
			1350	
			260	
			4050	

£ 3
20
4050 (27
250
15

If 4 pounds cost 1 s. 5 d. what will 8765 pound cost?

lib.	s.	d.	lib.
4	1	5	8765
	12		17
	17		61355
			8765
			149005

```
 212 (1        1  (3
149005        37251 (3104 (155
 44444        12222
                 111
```

Ans. 155 *l.* 4 *s.* $3\frac{1}{4}$ *d.*

If 15 Ells cost 7 *l.* 10 *s.* what are $27\frac{1}{2}$ ells worth?

Here because there are half ells in the Question, you must therefore turn your 15 Ells into halves, by multiplying them by 2, and they make 30 half ells; also you must turn your 27 ells and a half, into halves, and they make 55 half ells: then will the work stand as here you see.

Ells	*l.*	*s.*	*Ells*
15	7	10	$27\frac{1}{2}$
2	20		2
30	150		55
	55		
	750		
	750		
	8250		

```
 21        1
 8250 (27|5
 3000   13
  33
```

Ans. 13 *lib.* 15 *sh.*

If 27 ells and $\frac{1}{2}$ cost 13 *l.* 15 *s.* what he 15 ells worth?

Ells	*l.*	*s.*	Ells
$27\frac{1}{2}$	13	15	15
2	20		2
55	275		30
	30		
	8250		

```
 22
 37        1
 8250 (15|0
 5555   7
  55
```

CHAP. VIII.

The RULE of THREE, *Reverse*, Or, The Backward GOLDEN RULE.

SOme there are that make no difference between the Direct and the Reverse Rule of Three, but only in stating of the Question and placing of the Numbers: But as in the Direct Rule you multiplied the second and third numbers together, and divided the product by the first; in this Reverse Rule you must

Multiply the First Number by the second, and divide the product by the third, the quotient shall be the Fourth Number required, and be (as in the Direct Rule) of the same Denomination with the second Number.

Objection.

But here it may be questioned, How shall I know, when a Question is propounded, whether it must be wrought by the

forward or the backward Rule?

Answer.

This General Rule is to be observed, *If more require more, or if lesse require lesse, the Question must be wrought by the forward Rule.* But, *If more require lesse, or lesse require more, then must you use the reverse or backward Rule.*

The Examples following will make this plain.

Question.

If 24 Pioneers require 16 Moneths to dig a Trench or Ditch about a City, how many Pioneers must there be employed to dig the like Trench or Ditch in 4 Moneths time?

Here 24 is not the first number, though it be first named, but the three numbers placed in order, stand thus:

16 24 4

For the middle term must alwayes be of the same denomination with that which is required, as in the Rule of Three Direct.

Now multiply 24 by 16, the product is 384, which divided by 4, the quotient is 96, and so many Pioneers must be employed to dig the Trench in four Moneths.

Mon.	*Men*	*Moneths*
16	24	4
	16	
	144	
	24	
	384	

For

For if 16 moneths require 24 men, then (a fourth part of 16, which is) 4 moneths shall require (four times 24, that is) 96 men.

For here, lesse requires more, that is, lesse time, more hands; and therefore is it wrought by the reverse Rule.

Question 2.

If 1 Close would graze 21 horses for 6 weeks, how many horses would it feed for 7 weeks?

Multiply 21 by 6 it produceth 126, which divided by 7, the quotient is 18. At that rate therefore it would keep 18 horses for 7 weeks.

Weeks	*Horses*	*Weeks.*
6	21	7
	6	
	126	7 126 (18
		7
		56

Question 3.

If one Close will feed 18 horses for 7 weeks, how long shall it feed 63 horses?

Multiply (according to the Rule) 18 by 7, the product is 126, which divided by 63, the quotient is 2, therefore two weeks it shall keep them.

Horses	Weeks	Horses
18	7	63
7		
126		

This rule serves indifferently for hay oats, or any other provision for Man or Beast, which may be of use in Garrisons, and such like cases where scarcity may be feared, to proportion either the mouths to the meat, or the meat to the mouths.

I will say no more of this Rule, only give you three or four Examples for practice.

Other Examples for practice.

One lent my Friend 400 *l.* without interest for 7 moneths; the Question is, how much he ought to lend me for twelve moneths, to requite my courtesie?

Months	lib.	Months
7	400	12
	7	
	2800	

xx
44(4 l. f. d.
288(233 6 8
xxxx
xx

I lent my Friend 233 l. 6 s. 8 d. for 12 moneths without interest, upon condition he should upon occasion do me the like pleasure: the Question is, how much he ought to lend me for 7 moneths to requite my courtesie?

Moneths	l.	s.	d.	Moneths
12	233	6	8	7

20

4666

12

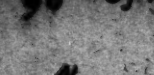
9340
4666

56000

12

112000
56000

672000



Anſ. 400 *lib.*

I lent my friend 400 *l.* for 7 moneths, upon condition that he ſhould do the like for me; but when I came to borrow of him, he could lend me but 233 *l.* 6 *ſ.* 8 *d.* how long ought I to keep it to ſave my ſelf harmleſs?

l.	*Moneth*	*l.*	*ſ.*	*d.*
400	7	233	6	8
20		20		
8000		4666		
12		12		
16000		9340		
8000		4666		
96000		56000		
7				
672000.				

x
xx
67xxxx (12 Moneths
56xxxx
56xxx

I lent my friend 233 l. 6 s. 8 d. for 12 moneths, how long ought he to lend me 400 l. to save himself harmless?

l.	s.	d.	Moneths	l.
233	6	8	12	400
20				20
4666				8000
12				12
9340				16000
4666				8000
56000				96000
12				
112000				
56000				
672000				

CHAP. IX.

The *Golden Rule*, compounded of five Numbers: Commonly called, *The Double* RULE of THREE.

THis Rule is an abbreviation of the common Rule of Three Numbers, for that it performeth that at one working, which the other Rule of Three effecte that twice.

When any queſtion appertaining to this Rule is propoſed, you muſt firſt diſpoſe the five Numbers in ſuch ſort, that the ſecond number and the fifth be of the ſame denomination, and that the third or middle number of the five, be of the ſame denomination with that which is ſought.

The Numbers being thus diſpoſed, you muſt work by this following Direction.

THE RULE.

Multiply the firſt and ſecond Numbers together, the product of them ſhall be your Diviſor. Again, multiply the three laſt Numbers one by another, (that is) the third by the fourth, and the fourth by the fifth, that laſt

produ-

product shall be your Dividend; and the Number produced by that Division shall answer the question, and be of the same denomination with the third or middle Number.

Question 15

If 6 men in 2 weeks build 23 Rod of wall, how many Rod will 24 men build in 12 weeks?

First place your Numbers as here is done, where you may see that the second Number and the fifth are of the same denomination, *viz.* both *Weeks*, and that the third or middle Number is *Rods*, of which denomination must the Number sought be.

Men	weeks	Rod	Men	weeks
6	2	23	24	12
	6		23	
	12		72	
			48	
			552	
			12	
			1104	
			552	
			6624	

xx
6624 (552 Rod.
xxxx
xx

Your Numbers being placed as you here see, multiply 6 by 2, it makes 12 for your Divisor. Then multiply 23 by 24, and it maketh 552, that again multiplied by 12, (the fifth Number) produceth 6624 for your Dividend.

Lastly, Divide 6624 by 12, and the Quotient will be 552; and so many Rod of the like wall will 24 men build in 12 weeks.

Question

Question 2.

If a hundred weight (that is, 112 *lib.* weight) carried 120 miles, cost 14 *s.* how much shall three quarters of a hundred (that is, 84 pound) cost, being carried 40 miles?

First, place your numbers according to the tenor of the Question thus:

l.	*Miles*	*s.*	*l.*	*Miles*
112	120	14	84	40

120 14

2240 28

112 14

13440 168 pence.

84

672

1344

14112

40

564480

28
x488
564480 (42
x33600
1744.

Your numbers being placed in order, reduce the 14 s. into pence, and it is 168 pence, then multiply 168 by 84, the product is 14112, which multiplied by 40, (the last number) it produceth 564480, for the Dividend.

Then multiply 112 by 120, it produceth 13440, for the Diviſor.

Divide 564480 by 13440, the Quotient will be 42 pence, which is 3 s. 6 d. and answers the Queſtion.

Thus in this Rule you may obſerve, that the firſt number and fourth, the ſecond and fifth, and alſo the third and ſixth are of like denominations.

Queſtion 3.

If 100 l. for 6 moneths yield 3 l. intereſt what ſhall 625 pound yield for 36 moneths?

Multiply the three laſt, as before is ſhewed, the later product is 67500, for the Dividend,

vidend. And the two first numbers multiplied make 600 the Divisor; then divide 67500 by 600, (or 675 by 6, which is all one) the quotient will be 112 whole pounds, and 300 (or 3) remaining; which because it is half the Divisor, signifies half the half of a pound, that is, 10*s*. So the answer to the question is 112*l*. 10*s*.

l.	*m.*	*l.*	*l.*	*m.*
100	6	3	625	36
6			3	
600			1875	
			36	
	2(3		22500	
675	(112		5625	
606				
			67500	

Which might have been given in one denomination, namely, 2250 shillings, if before the work the pounds had been turned into shillings, by multiplying them by 20, as hath been shewed before.

But since most questions, except such as are designed for the purpose, are apt to end in some Fraction, I shall next treat of Fractions. Only

Only take notice, that all questions which are wrought at once by this compound Rule of five Numbers, may be done at twice by the single Rule of Three; and the doing of them so by two operations, is called the Double Rule of Three.

As in our last question there are two things considerable, the money, and the time.

First, for the money.

Say, if 100 *l.* give 3 *l.* what 625 *l.* answer, 18 $\frac{75}{100}$ *l.*

Secondly, for the time,

Say, if 6 *mo.* give 18 $\frac{75}{100}$ *l.* what 36 *m.* answer, 112 $\frac{50}{100}$ *l.*

But this will be better understood, when Fractions are learned, which now we come to teach.

CHAP.

CHAP. X.

Of FRACTIONS.

A Fraction is the part of any entire thing, as when any thing is broken or divided into parts, those parts are called Fractions; as if a Pound in money be broken or divided into ſhillings, 17 *ſ.* is ſeventeen twenties of a pound, alſo 10 *ſ.* is ten twenties of a pound. Likewiſe if a ſhilling be the integer, then pence are the Fraction parts thereof; as 7 pence is ſeven twelfths of a ſhilling, 5 pence is five twelfths of a ſhilling, and ſo of any other number of pence. Alſo if a peny be the integer, then farthings are the Fraction parts thereof; as 3 farthings is three fourths of a peny, 2 farthings is two fourths of a penny, and one farthing is the one fourth of a peny.

And the like is to be underſtood of any other thing that may be parted, as of Weight, into Pounds, Ounces and Drams; or of Meaſure into Buſhels, Pecks, Gallons, Quarts, *&c.* Or any other thing that may be broken into parts.

In

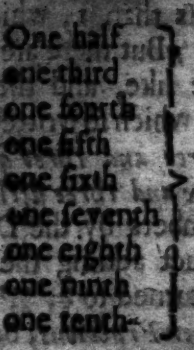
In Fractions we will begin first with *Numeration*, then with *Multiplication* and *Division*, then with *Reduction*, and lastly with *Addition* and *Subtraction*. And the reason why I so do will evidently appear by the work following; for *Multiplication* and *Division* are easier than *Addition* and *Subtraction*, and may be performed without *Reduction*, which the other two cannot be.

Numeration of FRACTIONS.

NUmeration of Fractions teacheth how to write any Fraction down, and also how to expresse any Fraction that is already written; and that this may be done, we must consider that any Unite, or Number representing an Unite, may be broken into two parts equal, and then each of the parts is called *one half*; or it may be parted into three equal parts, and then each part is called *one third*; and two of them are called *two thirds*: and the like may be understood if the unite were parted into 4, 5, 6, 7, 8, 9, 20, 50, or 100, or how many soever parts:

Now to write these, do thus:

One



In every one of these nine Fractions, the Number below the line is called the *Denominator*, and it shews into how many parts the unite is broken.

The Number above the line shews how many of those parts are taken, or contained in the Fraction, & is thence called the *Numerator*: So in the Fraction $\frac{3}{5}$ the Denominator 5 shews the unite to be broken into 5 parts, and the Numerator 3, signifies 3 of those parts to be contained in the Fraction, which Fraction therefore is called *three fifths*.

So that all Fractions are quotients of lesser numbers divided by greater, as $\frac{4}{7}$ signifies 4 to be divided by 7; and the line of separation which is drawn between the 4 and the 7, doth properly signifie Division.

Hitherto we have spoken only of such Fractions

ctions as are leſs than 1, which are called *Proper Fractions*. But there are alſo $2\frac{1}{2}$, $3\frac{3}{4}$, $5\frac{1}{7}$, $6\frac{1}{5}$, and the like, and theſe are called mixed Numbers, which ſo written ſignifie *two and an half, three and three quarters, five and a ſeventh, ſix and three fifths.* Theſe by multiplying Numbers by the Denominator, and to the product adding the Numerators reſpectively, are turned to $\frac{5}{2}$, $\frac{15}{4}$, $\frac{36}{7}$, $\frac{33}{5}$, which are called *Improper Fractions*, becauſe every one of them contains more than unitie.

Theſe nevertheleſs may be multiplied, divided, added or ſubſtracted in the ſame way as proper Fractions are.

Multiplication of FRACTIONS

ALl proper Fractions (which are all Fractions leſs than One) are ſtill made leſs by multiplying; and for Multiplication this is

THE RULE.

Multiply all the Numerators together, the laſt product ſhall be the Numerator of the product required: Likewiſe multiply all the Denominators together, the laſt product ſhall be the

the Denominator of the product sought.

Example 1.

If $\frac{3}{5}$ be to be multiplied by $\frac{4}{9}$ multiply the Numerator 3 by the Numerator 4, the product is 12, for the numerator of the new product. Also multiplying the Denominator 5, by the Denominator 9, they produce 45, for the Denominator of the desired product, so that the product which was required is $\frac{12}{45}$.

Example 2.

If $\frac{1}{2}$, $\frac{3}{4}$, $\frac{4}{5}$, $\frac{5}{9}$, and $\frac{3}{11}$, were to be multiplied altogether, begin with the Numerators, saying, once 3 is 3, and 3 times 4 is 12, and 12 times 5 is 60, and 60 times 3 is 180, for the Numerator: Then multiply the Denominators, saying, 2 times 4 is 8, and 8 times 5 is 40, and 40 times 9 is 360, and 360 times 11 is is 3960 for the new Denominator. So that the product of all these is $\frac{180}{3960}$.

Example 3.

To multiply the mixt Numbers, $3\frac{1}{2}$, $4\frac{1}{3}$, $5\frac{3}{4}$: First (as hath been shewn already) turn them into improper Fractions, thus, first say,

2 times 3 is 6 and 1 is 7. So the first is $\frac{7}{3}$. Secondly, 3 times 4 is 12 and 1 is 13. So the second is $\frac{13}{4}$. Lastly, 4 times 5 is 20, and 3 is 23. So the last is $\frac{23}{5}$. Now the Fractions to be multiplied are $\frac{7}{3}$, $\frac{13}{4}$, and $\frac{23}{5}$. First, for a new Numerator, say, 7 times 13 is 91; and 91 times 23 is 2093, for a new Numerator.

Then say, 2 times 3 is 6, and 6 times 4 is 24. So the new Denominator is 24.

And the product of all these Fractions is $2093/24$, that is, if real Division be made, $87\frac{5}{24}$.

Division of FRACTIONS.

DIvision of one Fraction by another, is but the cross multiplying of them, for which this is

THE RULE.

Multiply the Numerator of the one, by the Denominator of the other, and hereby the proportion of one Fraction to another is seen.

Example

Example 1.

Divide $\frac{3}{4}$ by $\frac{6}{8}$, to do it, set them thus: and multiply as the Croſs leads, ſaying, 3 times 8 is 24, for a new Numerator, and 6 times 4 is alſo 24 for a new Denominator. So the quotient is $\frac{24}{24}$, that is 1, which ſhews the Fractions to be equal one to another.

Example 2.

Divide $\frac{3}{5}$ by $\frac{4}{9}$, Firſt, ſet them thus, and ſay, 5 times 9 is 27, for a Numerator: And 5 times 4 is 20, for the Denominator. So the quotient is $\frac{27}{20}$, and ſo many times is $\frac{4}{9}$ contained in $\frac{3}{5}$.

In Diviſion it is to be remembred, that the *Numerator* of the quotient ever ariſeth of the Numerator of the *Dividend*; and the *Denominator* of the quotient comes of the denominator of the *Dividend*, each being croſs multiplied, as before.

If a Fraction be to be divided by a whole Number,

Number, multiply the denominator by that Number, the product gives the new denominator, and the Numerator remains the same. So if $\frac{2}{4}$ be divided by 9, say 9 times 4 is 36. So the quotient is $\frac{1}{36}$.

Or if $\frac{1}{4}$ were to be multiplied by 9, the product (by multiplying the Numerator by 9) will be $\frac{9}{4}$, that is, $2\frac{1}{4}$.

Example 3.

$$\begin{array}{ccc} & 2880 & \\ \frac{320}{8} & \times & \frac{45}{9} \\ & 360 & \end{array}$$

Divide $\frac{320}{8}$ by $\frac{45}{9}$, thus, say, 320 times 9 is 2880 for a Numerator: and 8 times 45 is 360 for a denominator. So the Quotient is $\frac{2880}{360}$.

Reduction of FRACTIONS.

OF Reduction of Fractions there are three varieties.

1 To reduce a Fraction to a lesser denomination.

2 To reduce many Fractions of divers denominations, to one denomination.

3 To reduce any Fraction from one denomination (as near as may be) to any other denomination desired.

For

For the first of these, this is

THE RULE.

Divide both the Numerator and the Denominator by the greatest common Divisor that you can think of, the two quotients being placed respectively in a Fraction, that Fraction shall be equal to the former Fraction, and in lesser terms.

So (in the third Example of Division to reduce $\frac{2880}{3600}$ to $\frac{8}{10}$, divide 2880 by 360, the quotient is 8; then divide 360 by 360, the quotient is 1, and the new Fraction $\frac{8}{1}$ is equal to the former Fraction, $\frac{2880}{3600}$, and in less terms as you may see. But to find the greatest common Divisor, this is

THE RULE.

Divide the greater term by the lesser, (I mean by terms, the Numerator and Denominator) *and by the remainder* (*if any be*) *divide the divisor, and if any thing still remains, by that divide the last divisor, continuing this course till nothing remain greater than unity, that Divisor which is last of all is the greatest common measure of both terms,*

by which both being divided, and the quotients placed like a Fraction, that Fraction shall be equal to the former Fraction, and in the least terms.

Example.

Reduce $\frac{148}{16}$ to the least terms; first divide 148 by 16, the quotient is 9, and 4 remains: again divide 16 by 4, the quotient is 4, and nothing remains; wherefore taking 4, (the last divisor) for the greatest common divisor by it divide 148 the quotient is 37, and by it divide 16, the quotient is 4. These two last quotients placed orderly in a Fraction, make $\frac{37}{4}$, which is equal to $\frac{148}{16}$, and in the least terms; for no number greater than 1, will divide evenly both 37 and 4.

Now secondly, to reduce many Denominations to one common Denominator; let the Fractions be $\frac{1}{2}, \frac{3}{4}, \frac{4}{5}, \frac{7}{8}, \frac{9}{10}$, to be reduced all to the Denomination 3200.

THE RULE.

Multiply all the Denominators together, saying, 2 times 4 is 8, and 8 times 5 is 40, and 40 times 8 is 320, and 320 times 10 is 3200; this last product 3200, shall be the

common

common Denominator. Then to get Numerators for every one of them: *Multiply every particular Numerator into all the Denominators except his own:* As first, for the first, say, once 4 is 4, and 4 times 5 is 20, and 20 times 8 is 160, and 160 times 10 is 1600.

For the first Numerator: So the first Fraction reduced is $\frac{1600}{3200}$. Then for the second Numerator, say, 3 times 2 is 6, and 6 times 5 is 30, and 30 times 8 is 240, and 240 times 10 is 2400. So the second Fraction reduced, is $\frac{2400}{3200}$. After the same manner may the other three be reduced to $\frac{2560}{3200}$ for the third; $\frac{2800}{3200}$ for the fourth; and $\frac{2880}{3200}$ for the last. These are severally equal to the other, the first to the first, *&c.* as may be proved thus,

Let the unite be a pound *Sterl.* then

	l.	*s.*	*d.*
The $\frac{1}{2}$ of it is	10		
and $\frac{3}{4}$ is	15		
and $\frac{4}{5}$ is	16		
and $\frac{7}{8}$ is	17	6	
and $\frac{9}{10}$ is	18		
In all	76	6	

That is 3 whole unites, and 16 *s.* and 6 *d.* over. Turn 16 *s.* 6 *d.* all to six pences, it is

33, and because 6 *d.* is the fortieth part of a pound, therefore all the Fractions are equal to $3\frac{33}{40}$.

Now add the new Fractions which (being all of one denomination) may be added like whole Numbers, thus:

1600
2400
2560
2800
2880
In all 12240

Which divided by the Denominator 3200 the quotient is $3\frac{1640}{3200}$. Now $\frac{1640}{3200}$, reduced to the least terms, as hath been shewed how it may, will be $\frac{33}{40}$, so the sum of these also is $3\frac{33}{40}$, which is equal to the sum of the Fractions given to be reduced, and therefore they are equal in sum, and might be thus proved equal severally, that is, the first of them propounded, to the first reduced. Divide the Numerator 1600 by the Numerator 1, quotient is 1600. Also divide the Denominator 3200, by the Denominator 2, the quotient is also 1600, and so may any of the rest be proved equal by the equality of quotients.

Thirdly, Any Fraction being given, to change the Denomination to any other more

requisite, retaining still (as near as may be) the same value.

THE RULE.

Multiply the Numerator given, by the Denominator required, and divide the product by the Denominator given, the quotient shall be the Numerator required.

Example.

Let the Fraction given be $\frac{7}{13}$ of a pound *Sterling*, what is that in twentie parts, or shillings? Multiply 7 by 20; the product is 140, which divided by 13, the quotient $10\frac{10}{13}$, that is, 10 *s.* and $\frac{10}{13}$ of a shilling; which may be brought to pence thus, multiply 10 by 12, product is 120, which divide by 13, quotient $9\frac{3}{13}$ *d.* And again, multiply 3 by 4, the product is 12, which divided by 13, quotient is $\frac{12}{13}$ of a farthing, so seven thirteenths of a pound is 10 *s.* 9 *d.* and almost a farthing.

Fractions of Fractions.

In the Reduction of Fractions, some make another, or more parts, as Fractions of Fra-

ctions for one; that is, when there is a part of a fraction, or part of a part of a fraction, *&c.* to be valued in one Fraction.

THE RULE.

Multiply all the Numerators together, the last product shall be the Numerator desired: then multiply all the Denominators together, and this last product shall be the Denominator sought.

Example.

Let the Fractions of Fractions propounded, be $\frac{3}{5}$ of $\frac{4}{7}$ of $\frac{1}{2}$, for so they are usually written; and let the Numerators be multiplyed, saying, 4 times 3 is 12, and 12 times 1 is 12, the Numerator therefore required is 12; then for the Denominator, say, 5 times 4 is 20, and 20 times 2 is 40, for the Denominator required; and $\frac{12}{40}$ is equal to $\frac{3}{5}$ of $\frac{4}{7}$ of $\frac{1}{2}$.

Proof.

Let the Unite be 40 *s.* one fifth of 40 is 8, and therefore $\frac{3}{5}$ is 32, of which one fourth is 8, and $\frac{4}{7}$ is 24, of which one half is 12, and

therefore

therefore $\frac{12}{4}$ is the just sum of all the Fractions, This needs no further exemplifying.

Addition of FRACTIONS.

IN the Adding of many Fractions into one sum, you are to consider whether they be of one Denomination or divers; if of one, then this is

THE RULE.

Add all the Numerators together into one sum, that sum is the new Numerator: and the Denominator is the same. As for

Example.

Let the Fractions to be added be $\frac{2}{4}$, $\frac{4}{4}$, $\frac{5}{4}$, $\frac{1}{4}$, add the Numerators; saying 2 and 4 is 6, and 6 and 5 is 11, and 11 and 1 is 12. So the sum of them all is $\frac{12}{4}$, that is 3 unites.

As, let the Unite be 20 *s.* one fourth is 5 *s.* and $\frac{2}{4}$ is 10 *s.* and $\frac{4}{4}$ is 20 *s.* which added to 10 *s.* is 30 *s.* then $\frac{4}{5}$ is 25 *s.* which added to thirty shillings gives 55 *s.* And lastly, $\frac{1}{4}$ is 5 *s.* which added to 55 *s.* makes 60 *s.* that is 3 times 20 *s.* that is 3 *l.* or 3 Unites.

But if the fractions to be added, be of divers denominations, as let them be $\frac{3}{5}$, $\frac{3}{4}$ $\frac{4}{5}$, $\frac{7}{8}$, then (by the reduction afore going) they must be turned all into one denomination, and then they will be $\frac{320}{480}$, $\frac{360}{480}$, $\frac{384}{480}$, and $\frac{420}{480}$, and may be added like those before, thus.

320
360
384
420

In all 1484

So the sum of all is $\frac{1484}{480}$, or $\frac{371}{120}$, that is 3 $\frac{11}{120}$, which if it be money, and the Unite 1 *l.* it is then 3 *l.* 1 *s.* and 10 *d.* as may be tryed thus. First, $\frac{2}{3}$ of a pound, is 13 *s.* and 4 *d.* and $\frac{1}{4}$ is 15 *s.* and $\frac{4}{5}$ is 16 *s.* Lastly, $\frac{7}{8}$ is 17 *s.* 6 *d.* These all added together, the sum is 3 *l.* 1 *s.* 10 *d.*

	l.	*s.*	*d.*
$\frac{2}{3}$ of a pound is	0	13	4
$\frac{1}{4}$ of a pound is	0	15	0
$\frac{4}{5}$ of a pound is	0	16	0
$\frac{7}{8}$ of a pound is	0	17	6
In all	3	1	10

Substractions of FRACTIONS.

IN Substracting of one Fraction from another, if they be both of one denomination, this is

THE RULE.

Take the Numerator of one from the Numerator of the other, the remain is the new Numerator, and the Denominator the same as before.

So if $\frac{2}{5}$ be substracted from $\frac{7}{5}$, the remain is $\frac{5}{5}$, the like of all others.

But if they be not of one Denomination, they must first be reduced to be so, and then the substraction is the same as before.

The golden Rule in Fractions is the same as in whole Numbers, I will give you but one instance here by the way, and Exemplifie it in the Rule it self, both direct and reverse, in the two next Chapters.

If $\frac{1}{4}$ of a yard of tape cost $\frac{1}{5}$ of a peny, what shall one inch, that is $\frac{1}{36}$ of a yard cost?

Multiply the second by the third, the product is $\frac{1}{144}$, which divided by $\frac{1}{4}$, the quotient

is $\frac{4}{216}$ of a peny, for the price of $\frac{1}{2}$ of a yard.

Otherwise.

Seeing $\frac{1}{4}$ of a yard may be turned to 27 inches; Say, if 27 cost $\frac{1}{2}$ what 1? divide $\frac{1}{2}$ by 27, it makes $\frac{1}{54}$ for the answer, which is equal to $\frac{4}{216}$, and in the least terms.

And whersoever this may be done, to have the first and third Numbers fractions of one denomination, the best way is to work with their Numerators, not regarding their Denominators at all: as if $\frac{2}{3}$ cost $\frac{3}{4}$, what $\frac{7}{3}$? instead thereof write, if 2 cost $\frac{3}{4}$, what 7? multiply $\frac{3}{4}$ by 7, it produceth $\frac{21}{4}$, which divided by 2, the quotient is $\frac{21}{8}$, and that is the answer in the least terms.

And all this while it should have been noted that Fractions are ever written in a smaller figure then the whole Numbers.

CHAP.

CHAP. XI.

The Golden Rule, *or* Rule of Three *Direct in Fractions.*

THe manner of working the Golden Rule in Fractions differs little from that in whole Numbers. As by the Examples in the former Chapter may appear: The manner of working of it is in general thus, and this is

THE RULE.

Multiply the Numerator of the first Fraction by the Denominator of the second, and that by the Denominator of the third, for your divisor.

Again, *Multiply the Denominator of the first number, by the Numerator of the second, and that by the Numerator of the third, for your dividend.*

An Example or two will make it plain.

Question 1.

If $\frac{3}{4}$ of an Ell of Linnen-Cloath cost $\frac{1}{2}$ of a Crown, what shall $\frac{7}{10}$ of an Ell cost?

Place the numbers as these following.

Ells.

Ells	Cr.	Ells
$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{36}$

By your Rule, Multiply 3, the Numerator of the first Fraction, by 2 the Denominator of the second Fraction, and it maketh 6, that multiply by 36, the Denominator of the third Fraction, produceth 216, which is your divisor.

Again, Multiply 4 the Denominator of the first Fraction, by 1 the Numerator of the second, it is still 4, that multiply by 1, the Numerator of the third, produceth still 4, for your Dividend; which being lesse than the Divisor, must be set thus $\frac{4}{216}$, of a Crown; for the price of $\frac{1}{36}$ of an Ell, which in the least terms is $\frac{1}{54}$. See the work.

Ells	Cr.	Ells
$\frac{3}{4}$	$\frac{1}{2}$	$\frac{1}{36}$
$\frac{1}{4}$	$\frac{2}{36}$	$\frac{2}{216}$
$\frac{1}{4}$		
	$\frac{4}{216}$	

Question 2.

If $\frac{7}{8}$ of an ounce of Silver, cost $\frac{4}{36}$ of a pound Sterling, what shall $\frac{3}{8}$ of an ounce cost?

Answ.

Anſw. $\frac{108}{1820}$, or in leſſer terms $\frac{27}{455}$. See the work.

on.	*l.*	*on.*
$\frac{7}{9}$	$\frac{4}{10}$	$\frac{3}{13}$
4	7	
36	140	
3	13	
108	420	
	140	
	1820	

Other Examples.

If $\frac{3}{4}$ of a yard of Velvet coſt $\frac{2}{3}$ of a pound Sterling, what ſhall $\frac{5}{8}$ of a yard coſt?

yn.	*on.*	*yn.*
$\frac{3}{4}$	$\frac{2}{3}$	$\frac{5}{8}$
2	3	
8	9	
5	6	*Anſw.* $\frac{40}{54}$ or $\frac{7}{12}$
40	54	

If

If $\frac{11}{12}$ of an ounce of Silver be worth $\frac{13}{4}$ of a Crown, what is $\frac{1}{2}$ worth?

ON.	CR.	ON.
$\frac{11}{12}$	$\frac{13}{4}$	$\frac{1}{2}$
12	11	
24	44	
12	2	
144	88	
1		
144		

(5
6(6
144 (1
88

Anſ. 1 $\frac{56}{144}$ or 1 $\frac{7}{18}$.

CHAP.

CHAP. XII.

The RULE of THREE Reverse in FRACTIONS.

IN this Rule you must go contrary to the former, as in whole numbers; For this is

THE RULE.

Multiply the Numerator of the first Fraction, by the Numerator of the second Fraction, and the Product by the Denominator of the third, for your Dividend, then the Denominator of the first, by the Denominator of the second, and that by the Numerator of the third, for your divisor.

Question 1.

If when the price of a Quarter of Wheat is 2 *s.* the farthing white loaf shall weigh 68 *s.* I demand then what such a loaf shall weigh when the quarter of Wheat is worth 3 *s.*

s.	s.	s.
$\frac{2}{20}$	$\frac{68}{20}$	$\frac{3}{20}$
68	20	
2	20	
136	400	
20	3	
2720	1200	

Answer, (3 *l.* *s.* *d.*
~~27~~(20(2$\frac{32}{52}$, or 2 5 4
~~1200~~

Question 2.

When the price of a Quarter of Wheat is 9 *s.* what shall the farthing white loaf weigh?

s.	s.	s.
$\frac{2}{20}$	$\frac{68}{20}$	$\frac{9}{20}$
68	20	
2	20	
136	400	
20	9	
2720	3600	

Answer, $\frac{272}{360}$ or *l.* 00 *s.* 15 *d.* 1$\frac{1}{2}$

Note

Note that by a ſhilling you muſt underſtand $\frac{1}{20}$ of a pound weight, and ſo by a peny $\frac{1}{12}$ of an ounce of the Aſſize of bread, as by the Examples doth appear.

Note alſo in this Rule, if all your 3 numbers be of one Denomination, you ſhall work only with the Numerators, as in the ſecond Example.

CHAP.

CHAP. XIII.

The RULE *of* FELLOWSHIP, *without Time.*

OF this Rule of Fellowship, there are two kinds, the one with Time, the other without Time, It is a right necessary Rule for Merchants, Partners in Ships, Adventurers at Sea, and all such as Trade in Company with a joynt Stock, and are to share a proportional part either of Gain or Loss.

We will begin with Fellowship without Time, to work which this is

THE RULE.

Add the several Sums, that the several persons Adventuring put into Stock all together, which sum shall be the first number in the Rule of Three Direct. Then, *the sum that is either gained or lost in the Adventure shall be the second number in the Rule of Three:* And *The third number in the Rule shall be the sum of money that every person put into Stock severally.*

Question

Question. 1.

Simon, *George* and *Peter*, make a Stock of money to the value of 3762 *l.* which they imploy in Trade, till at length they make it worth 5430 *l.* *Simon* put in 563 *l.* *George* put in 765 *l.* and *Peter* put in 2434 *l.* how much must either of the parties have of the Gain, in full recompence of his money put in.

Add the several sums that the three parties put in together thus,

	l.
Simon put in	563
George put in	765
Peter put in	2434
The whole Stock	3762

First, for Simons *share, say.*

If 3762 *l.* the whole Stock, Gain 5430, what shall 563 *l.* Gain? which is *Simons* share put in.

Place your numbers as here you see, and working by the Rule of three, you shall find 812 *l.* $\frac{2346}{3762}$ parts of a pound, which is *Simons* share.

See-

See the work.

	l.		*l.*	
If	3762	gain	5430	what 563.

```
      563
    ------
    16290
   32580
  27150
  -------
  3057090

   (2
    3
    9(3
   104(4
   4785
  69947(6
 3057090 (812 2346/3762
  376222
   3766
    37
```

Secondly

Secondly, For Georges *share.*

	l.		*l.*	*l.*
If	3762,	Gain	5630,	what 765

```
        765
      ------
      27150
      3258
     3801
    -------
    4153950
       13(7
      3259(0
     149171(2
    4153950 (1104 [illegible]
    3762222
     37666
      377
       3
```

Thirdly, For Peters *share.*

	l.		*l.*	*l.*
If	3762,	Gain	5430,	what 2434

```
        5430
      -------
      73020
       9736
     12170
    --------
    13216620
```

1
43
1452(71
298992
413000(4
13216620 (3513 $\frac{714}{3762}$
3762222
37666
377
8

For *Peters* share 3513 $\frac{714}{3762}$

So that,

Simon gained	812 $\frac{2346}{3762}$
George gained	1104 $\frac{701}{3762}$
Peter gained	3513 $\frac{714}{3762}$
In all	5429 $\frac{3762}{3762}$

equal to the whole gain.

The Fractions being reduced into Coyn.

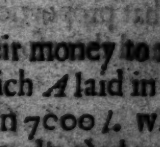
Simons share will be	812	12	5	2 $\frac{2964}{3762}$
Georges share will be	1104	3	8	3 $\frac{522}{3762}$
Peters share will be	3513	3	9	2 $\frac{276}{3762}$
The whole gain	5430	0	0	0

Which proves the work to be true.

Question

Question 2.

A. B. and *C.* joyn their money to make a Stock of 25000 *l.* of which *A* laid in 10000 *l.* *B* 8000 *l.* and *C* put in 7000 *l.* with this (after a certain time in trading) they gained 7500 *l.* how must this be parted?



First for A.

Say, if 25000 gain 7500, what 10000?

Or shorter, if 25 get $7\frac{1}{2}$, what 10? Multiply $7\frac{1}{2}$ by 10, it produceth 75, which divided by 25, the quotient is 3, that is, (restoring the 3 Cyphers) 3000 *l.* for *A.*

Then for B.

Say, if 25000 gain 7500, what 8000?

Or shorter, if 250 get 75, what 80?

Multiply and divide as the *Golden Rule* requires, and to the quotient, restore the two Cyphers, then it will be 2400 *l.* for *B.*

Lastly, for C.

Say, if 250 give 75, what 70? answer 21 to which put the two cyphers, it makes 2100 for *C.*

And

And these three, 3000, 2400, and 2100 being added together, make 7500. And have that proportion as the particular Stocks had: and therefore the work is right.

(I) *for* A.

If 25 gain $7\frac{1}{5}$, what 10 *l.*

150

$7\frac{1}{5}$ 15 X $\frac{10}{1}$

2

75 (3

75

(II) *for* B.

If 25000 gain 75, what 80?

80

250)6000(24

500

1000

1000

2400

(III)

(III) for *C*.

If 250 gain 75, what 70?

70

250)5250(21

500

250

250

2100 for *C*.

And if instead of gaining 7500 *l*. whereby every one is supposed to have his Stock and a part of the gains; they had lost 7500 *l*. then of their particular Stocks had been due to them but so much as would be left after their proportional parts of the loss were abated.

Question 3.

A B and *C* with a joynt Stock of 25000 *l*. gain 7500 *l*. of which *A* gets 5000. *B*. 2400 *l*. *C* 2100 *l*. what was their Stock?

This is but the Converse of the former; therefore say, if 5700 require 25000, what doth 3000 require? *Answer*, 10000 for *A*. and so work for the other two.

CHAP. XIV.

The RULE *of* FELLOWSHIP, *with* TIME.

IN this Rule of Fellowship with Time, there are two things chiefly to be considered, Namely, the difference of stock, and the difference of time. The best way to perform it is by multiplying the money and the time of each Adventurer together, and all those products added together to be the whole Stock. For,

As the Sum of these Products, is to the whole gain or loss;
So is each particular Product, to that particular mans gain or loss.

So then the Rule is wrought as that without time, as by Examples following will appear.

Question 1.

William, *Robert* and *Thomas*, make a Stock of 10000 *l.* *William* puts in 4000 *l.* for three moneths; *Robert* puts in 3000 *l.* for 6 moneths; and *Thomas* puts in 3000 *l.* for 8 moneths;

moneths; with this they gain 2000 *l.* what must each party have of the gain?

First for *William*, multiply 4000 *l.* his Stock by 3 his time, it makes 12000, which let be accounted his particular Stock.

Secondly, for *Robert*, multiply 3000 his Stock by 6 his time, it makes 18000 for his Stock.

Lastly, for *Thomas*, multiply 3000 his Stock, by 8 his time, it produceth 24000, for his Stock; these three added together, make 54000 *l.* which is the general Stock; then say,

For *William*.

If 54000 give 2000, what 12000? answer, $444\frac{24000}{54000}$.

Then for *Robert*.

If 54000 give, 2000, what 18000? answer, $666\frac{36000}{54000}$.

Lastly, for *Thomas*.

If 54000 give 2000, what 24000? answer, $888\frac{48000}{54000}$.

The three Fractions being reduced to leſſer terms will be $444\frac{4}{9}$, $666\frac{6}{9}$, and $888\frac{8}{9}$, which altogether make 2000 *l.* as they ought and as by the work following doth appear.

William 4000 *l.* for 3 moneths,

3

12000 *Williams* Stock.

Robert 3000 *l.* for 6 moneths,

6

18000 *Roberts* Stock.

Thomas 3000 *l.* for 8 moneths,

8

24000 *Thomas* Stock.

Theſe added make	}	12000
		18000
		24000
The general Stock.		54000

Then

Then for Williams *share, say,*

If 54000 gain 2000 *l.* what 12000?

2000

24000000

2(2

244(4

24000(000 (444 $\frac{24000}{54000}$

5444000

55 *Williams* share.

Then for Roberts *share.*

If 54000 gain 2000 *l.* what 18000?

2000

36000000

3(3

366(6

36000(000 (666 $\frac{36000}{54000}$

5444000

55 *Roberts* share

Lastly, for Thomas *share.*

If 54000 gain 2000 *l.* what 24000

2000

48000000

4 (4
488 (8
48000 (000 (888 $\frac{48000}{54000}$
5444000
55 *Thomas* share.

Which Fractions being Reduced, and the three shares added together, make 2000 *l.* which proves the work to be true.

$$\begin{array}{r} 444\frac{4}{9} \\ 666\frac{6}{9} \\ 888\frac{8}{9} \\ \hline 2000 \end{array}$$

Question 2.

Three Farmers, *A B* and *C* lay out 1000 *l.* to Stock their ground with Cattle, of which *A* put in 200 *l.* for 6 years, *B* had 300 *l.* going for four years, and *C* 500 *l.* for 2 years; at the end (by unseasonable times) there was lost 200 *l.* which made the remain of their Stock but 800 *l.* what was each mans Loss.

Multiply 200 by 6, it gives 1200. Likewise 300 by 4, it gives 1200. Lastly, 500 by 2, the product is 1000; all these are 3400 for the Joynt-Stock.

Then first for *A*.

Say, if 3400 lose 200, what 1200, answer

swer, $70\frac{2000}{3400}$ for *A* to which *B* is also equal, because their Stock and time together are equal.

Therefore, for *C*.

Say, if 3400 lose 200, what 1000? answer, $58\frac{2800}{3400}$. So the 3 shares are $70\frac{20}{34}$ $70\frac{20}{34}$ and $28\frac{28}{34}$, equal to 200.

Now because *A* put in 200 *l.* and lost $70\frac{20}{34}$ substract the loss from the Stock, remains $129\frac{14}{34}$.

And so doing for *B*, his remain will be $289\frac{14}{34}$.

And for *C*, his remain is $441\frac{6}{34}$.

Now these three remains, $129\frac{14}{34}$, $289\frac{14}{34}$, and $441\frac{6}{34}$, make up 800 *l.* which was the whole remain.

Question 3.

A Rents a Close for a year, to pay 80 *l.* he puts into it 200 sheep: 2 moneths after *B* puts 40 sheep in; and 5 moneths after that *C* puts in 100 sheep; how much must every one pay of the Rent?

Multiply 200 by 12, it produceth	2400
And 40 by 10, produceth	400
Laſtly, 100 by 5 produceth	500
In all	3300

Then for A.

If 3300 pay 80, what 2400? anſwer, $58\frac{600}{3300}$.

Then for B.

If 3300 pay 80, what 400? anſwer, $9\frac{2300}{3300}$.

And for C.

If 3300 pay 80, what 500? anſwer, $9\frac{400}{3300}$.

The whole numbers make 79, and the Fractions make 1, In all 80.

CHAP.

CHAP. XV.

The Rule of PRACTICE.

THe Rule of Practice is nothing else but a compendium of the Direct Rule of Three.

For the ready performance of this Rule, you are to know readily the even parts of one Peny, of one Shilling, one Pound, &c. Which these Tables following will plainly shew, and they must be learned by heart, which will be easie to do when you are any way accustomed to use them.

The even parts of a Peny.

1		
2	farthing is the	$\frac{1}{2}$
3		$\frac{1}{4}$

of a Peny.

The even parts of a Shilling, are

Pense.

6		$\frac{1}{2}$
4		$\frac{1}{3}$
3	is the	$\frac{1}{4}$
2		$\frac{1}{6}$
1		$\frac{1}{12}$

of a shilling.

This Table is thus to be read and learned.

Six pence is the $\frac{1}{2}$ of a shilling,

Three pence is the $\frac{1}{4}$ of a shilling,

One peny is the $\frac{1}{12}$ of a shilling, and

The manner of using this and the following Tables, will appear by the following Questions.

At sixpence the yard, what are 7632 yards worth?

Sixpence being the one half of a shilling, you must therefore take the half of 7632 and it is 3816, which are so many shillings, that Divide by 20 (which is done by cutting off the last figure towards the right hand, and taking the half of the other figures) there is 190 *l.* 16 *s.* which is the price of 7632 pound of any Commodity at 6 pence the pound.

See the work.

At 6 *d.* the pound, what 7632 pound?

6 *d.* $\frac{1}{2}$ | 3816

l.	*s.*	*d.*
190	16	0

At 4 *d.* the yard, what 9763 yards?

Four pence being $\frac{1}{3}$ of a shilling, take $\frac{1}{3}$ of the number.

At

At 4 *d.* the yard, what 9763 yards?

		d.
4 *d.* $\frac{1}{3}$	3254	4

l.	*s.*	*d.*
162	14	4

Here when you had taken the third part of 9763, it produced 3254 shillings, and one remaining which one remaining, representeth $\frac{1}{3}$ of a shilling, which is 4 *d.* and therefore set it down; Also when you took the half of 325, it produced 162, and one remaining, which one that remained representeth 10 *s.* which being joyned to that 4 that is cut off, maketh it 14 *s.* So the whole price comes to be 162 *l.* 14 *s.* 4 *d.*

I have been the larger in these two first Examples, because I intend only to set down the other that follow, and leave them to your own Practice.

At 3 *d.* the Gallon, what 3795 Gallons?

		d.
3 *d.* $\frac{1}{4}$	948	9 *d.*

l.	*s.*	*d.*
47	8	9

At 2 *d.* the pound, what 97625 pound?

		d.
	16217	10

d.	l.	s.	d.
$2\frac{1}{2}$	81	7	10

At 1 *d.* the ounce, what 6725 ounces?

		d.
1 *d.* $\frac{1}{12}$	5610	10

l.	s.	d.
28	0	5

Uneven parts of a Shilling.

The uneven parts of a shilling are 5 *d.* 7 *d.* 9 *d.* 10 *d.* and 11 *d.* Wherefore if any question be propofed, where any of these uneven numbers is the price, you must

For { 5, 7, 9, 10, 11 } pence take { 3 and 2 *d.*; 4 and 3 *d.*; 6 and 3 *d.*; 6 and 4 *d.*; 4 and 4 and 3 *d.* }

As by the Questions following will appear

At

At 5 *d.* the yard, what 758 yards?

3 *d.* $\frac{1}{2}$	189	6 *d.*
2 *d.* $\frac{1}{2}$	126	4 *d.*
	3115	10 *d.*

l.	*s.*	*d.*
15	15	10

At 7 *d.* the pound, what 563 pound?

4 *d.* $\frac{1}{3}$	187	8 *d.*
3 *d.* $\frac{1}{4}$	140	9 *d.*
	3218	5 *d.*

l.	*s.*	*d.*
16	8	5

At 8 *d.* the Ell, what 112 Ells?

4 *d.* twice $\frac{1}{2}$	37	4 *d.*
	37	4 *d.*
	714	8

l.	*s.*	*d.*
3	14	8

At

At 9 *d.* the douzen, what 498 douzen?

	249	*d.*
$6\frac{1}{2}$	124	3
$3\frac{1}{4}$		
	3713	3

l.	*s.*	*d.*
18	13	3

At 10 *d.* the Grofs, what 9769 Grofs?

	4884	6 *d.*
$6\frac{1}{2}$	3256	4
$4\frac{1}{3}$		
	81410	10

l.	*s.*	*d.*
407	0	10

At 11 *d.* the quart, what 7895 quarts?

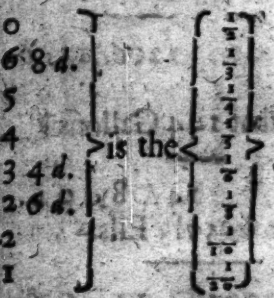
	2631	8 *d.*
$4\frac{1}{2}$	2631	8
$4\frac{1}{2}$	1973	9
$3\frac{1}{4}$		
	72317	1

l.	*s.*	*d.*
361	17	1

The

The even parts of a Pound Sterling, or Twenty Shillings.

The even parts of a pound or 20 *s.* are, 10 *s.* 5 *s.* 4 *s.* 2 *s.* 1 *s.* to which may be added 6 *s.* 8 *d.* and 3 *s.* 4 *d.* and 2 *s.* 6 *d.* some others, too many here to enumerate, or to trouble the Reader to retain in memory: but those sufficient for use this Table following declares.



At 10 *s.* the yard, what 372 yards?

$10\frac{1}{2}$ 1861.

At 6 *s.* 8 *d.* the pound, what 479 pound?

s.	*d.*		*s.*	*d.*
$6\frac{2}{3}$		159	13	4

At

At 5 *s.* the piece, what 984 pieces?

$5\frac{1}{4}$ 248 *l.*

At 4 *s.* the Ell, what 762 Ells?

$14\frac{1}{2}$ 152 *l.* 8 *s.*

At 3 *s.* 4 *d.* the yard, what 9621?

3 *s.* 4 *d.* $\frac{1}{2}$ 1603 *l.* 10

At 2 *s.* 6 *d.* the Pound, what 9653 pound?

2 *s.* 6 *d.* $\frac{1}{2}$ 1206 *l.* 12 *s.* 6 *d*

At 2 *s.* the Gallon, what 144 Gallons?

$2\frac{1}{10}$ 14 *l.* 8 *s.* 0 *d.*

At 1 *s.* the Ell, what 695713 Ells?

1 *s.* $\frac{1}{20}$ 3478 *l.* 14 *s.* 0 *d.*

Uneven parts of a pound Sterling, or twenty Shillings.

The uneven parts of twenty shillings are, 3, 6, 7, 8, 9, 11, 12, 13, 14, 15, 16, 17, 18, 19 *s.*

Wherefore, if any Question be put at any of

of these Rates, you must do as in the uneven parts of a shilling, take two such even parts as will make up your uneven part, As this Table shews.

3	Shillings take	2	and 1
6		4	2
7		5	2
8		4	4
9		5	4
11		10	1
12		10	2
13		10	2and 1
14		10	4
15		10	5
16		10	5and 1
17		10	5and 2
18		10	5and 3
19		10	5and 4

As by some Questions following,

At 16 *s.* the piece, what 7569 pieces?

10 *s.* $\frac{1}{2}$	3784	10
5 $\frac{1}{4}$	1892	5
1 $\frac{1}{10}$	378	9
	6055	4

At

At 19 *s.* the yard, what 2659 yards?

10 $\frac{1}{2}$	1329	10 *s.*
5 $\frac{1}{4}$	664	15
4 $\frac{1}{4}$	531	16
	2516	01

Many other Questions might be added, but let these suffice.

CHAP.

CHAP. XVI.

The *RULE of BARTER*, or, *EXCHANGE*.

THis Rule is of good use for Merchants and others, that have Factors in other Countries, who send their Masters over Commodities not proper for their Trade at home; so that the Merchant is forced to exchange or Barter them away for such Commodities as are in his way, or he hath occasion for: It is no other then the Rule of Three, and few Questions will make it plain

Question 1.

A Merchant hath 24 Broad-cloths, which he values at 10 *l.* 10 *s.* the piece, which he is willing to Barter for a parcel of *Mace*, at 12 *s.* the pound, how much *Mace* must he have for his 24 Cloths.

Say by the Rule of Three,

If 1 Broad-Cloth be worth 10 *l.* 10 *s.*
what are 24 worth,

Answer, 252 *l.*

Then say again by the Rule of Three.

If

If 12 *s.* buy one pound of *Mace*, what shall 252 *l.* or 5040 *s.* buy?

Answer, 420 *l.* of *Mace*, and so much *Mace* must he have for his 24 Broad-Cloths.

See the Work.

Broad-Cloth.			Mace.		
l-c.	*l.* *s.*	*l-c.*	*s.*	*p.*	*s.*
1	10 10	24	12	1	5040
	20				
	210				
	24				
	840				
	420				
	5040				
l.	*s.*	*d.*			
252	00	00			

Many words are needless, seeing the Rule it self is plain, only for Example, take these Questions following, with their Solutions and operations.

Two Barter, the one hath 420 pound of *Mace*, at 12 *s.* the pound, the other hath

Broad-Cloth

Broad-Cloth at 10 *l.* 10 *s.* the piece, how many *Broad-Cloths* ought he to give for all his *Mace*, *Answer*, 24.

Mace.			Broad-Cloath.				
p.	*s.*		*p.*	*l.*	*s.*	*d.*	*s.*
1	12	420					
		12	10	10		1	5040
			20				1
		840					
		420	210				5040
			18				
		5040	5040	(24 Broad-c.			
			xxxx				
		252 *l.*	xx				

Two Barter, the one hath 32 pieces of *Canvas*, at 16 *l.* 7 *s.* the piece, the other hath *Baise* at 2 *s.* 3 *d.* the Ell, how many Ells of *Baise* for all his *Canvas*, *Answer*, 4650 $\frac{2}{3}$ Ells.

Canvas.

Canvas.				Baise.				
can.	*l.*	*s.*	*can.*	*s.*	*d.*	*Ell.*	*l.*	*s.*
1	16	07	32	2	3	1	523	4
	20			12			20	
	327			27			10464	
	32						12	
	654						20928	
	981						10464	
	10464						125568	
	523 *l.* 4 *s.* 0 *d.*							

~~153~~
~~473~~(1
~~12556~~(8 (4650⅔
~~27777~~
~~222~~

Two Barter, the one hath 4650⅔ Ells of Baise, at 2 *s.* 3 *d.* the Ell, the other hath Canvas at 16 *l.* 7 *s.* the piece; how many pieces of Canvas for 4650⅔ Ells of Baise?

Answer, 32 pieces.

Baise.

Baise.				Canvas.				
ell.	*s.*	*d.*	*ell.*	*l.*	*s.*	*pi.*	*l.*	*s.*
1	2	3	$4650\frac{2}{3}$	16	7	1	523	4
3	12		3	20			20	
3	27		13952	07			10464	
			27	32				
			97664	327				
			27904					
			376704					

~~61~~
~~185~~
~~10464~~ (32 pieces.
~~3277~~
~~32~~

~~1122~~
~~376704~~ (125580
~~333333~~

~~1~~
~~274~~
~~125568~~ (104614
~~122222~~
~~1111~~ *l.* *s.* *d.*
523 4 0

Two Barter, the one hath Indigoe at 4 *s.* *per* pound, ready money, but in Barter he will have 4 *s.* 9 *d.* the other hath Kersie at 3 *s.* 6 *d.* the yard ready money, at what Price must he Rate

Rate his Kersie in Barter, that he may be no loser?

Say by the Rule of Three,

If 4 *s.* in Barter, give 9 *d.* what shall 3 *s.* 6 *d.* give?

s.	*d.*	*s.*	*d.*
4	9	3	6
12		12	
48		42	
		9	
		378	

(4
9(2
378 (78/48 or 7/8 viz. 3 1/2.
48

s.	*d.*	*q.*
3	6	0
0	7	3 1/2
4	1	3 1/2

The price of the Kersies by the yard must be

Two Barter, One hath 120 yards of Broad-Cloth, for which in ready money he will have 15 *s. per* yard, but in Barter he will have 18 *s. per* yard. The other hath Hops at 4 *l.* 5 *s.* the C. ready money, how must he rate

rate his Hops, and how many C. of Hops muſt he give for all his Broad-Cloath?

Firſt, 120 yards of Broad-Cloath at 18 *s.* (which is the price he will have *per* yard in Barter) comes to 108 *l.*

Secondly, if 15 *s.* ready money, gain 3 *s.* in Barter, what ſhall 4 *l.* 5 *s.* gain?

The Anſwer will be 17 *s.* wherefore he muſt Rate his Hops in Barter at 5 *l.* 2 *s.* *per* C.

Thirdly, ſay, If 5 *l.* 2 *s.* buy 1 C. of Hops, how many C. ſhall I buy for 108 *l.*? Multiply and Divide, and you ſhall finde 21 *C.* 0 *qr.* 19 $\frac{12}{21}$ *l.* And ſo many Hops muſt he give for his 120 yards of Cloath.

l.	*s.*	*C.*	*l.*	(1
5	2	1	108	22(8 C.
20			20	2160(21 $\frac{12}{21}$
102			2160	168

Rate his Kersie in Barter, that he may be no loser?

Say by the Rule of Three,

If 4 *s.* in Barter, give 9 *d.* what shall 3 *s.* 6 *d.* give?

s.	*d.*	*s.*	*d.*
4	9	3	6
12		12	
48		42	
		9	
		378	

(4
9(2
378 (7$\frac{42}{48}$ or $\frac{7}{8}$ *viz.* 3$\frac{1}{2}$.
48

s.	*d.*	*q.*
3	6	0
0	7	3$\frac{1}{2}$

The price of the Kersies by the yard must be } 4 1 3$\frac{1}{2}$

Two Barter, One hath 120 yards of Broad-Cloth, for which in ready money he will have 15 *s. per* yard, but in Barter he will have 18 *s. per* yard. The other hath Hops at 4 *l.* 5 *s.* the C. ready money, how must he rate

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Secondly, if 15 *s.* ready money, gain 3 *s.* in Barter, what shall 4 *l.* 5 *s.* gain?

The Answer will be 17 *s.* wherefore he must Rate his Hops in Barter at 5 *l.* 2 *s. per* C.

Thirdly, say, If 5 *l.* 2 *s.* buy 1 C. of Hops, how many C. shall I buy for 108 *l.*? Multiply and Divide, and you shall finde 21 *C.* 0 *qr.* 19 $\frac{39}{51}$ *l.* And so many Hops must he give for his 120 yards of Cloath.

l.	*s.*	*c.*	*l.*	(1
5	2	1	108	x2(8 C.
20			20	xx60(21 $\frac{2}{51}$
102			2160	x8

CHAP. XVII.

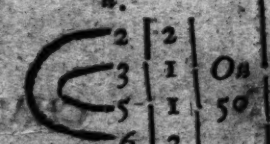
Of ALLIGATION.

THis Rule teacheth how to mix divers things, as Grains, Spices, Metals, Wools, *&c.* of different prices together, so that a Quantity may be made up of those Severalls, of any Price and any Weight required.

Question. 1.

A Grocer hath four several sorts of Spices one of 2 *d.* another at 3 *d.* a third at 5 *d.* and a fourth at 6 *d.* the Ounce, of these he would make a Mixture to contain 50 Ounces, and that each Ounce should be worth 4 *d.*

Place the prices of the several prices one under another as you see here in the Margine then, with a crooked line linck or joyn two of them together with this Condition, that you alwayes linck a greater and a lesser, as here I have done 2 and 6, and 5 and 3 and not 2 and 3, and 5 and 6.



This

This done place the price required, *viz.* 4 *d.* by it self towards the left hand, and towards the right hand note the several differences between the price of an ounce of every particular Spice, and of the price required as here the difference between 2 *d.* and 4 *d.* is 2 *d.* which I place (not against 2 *d.* the first price I took, but) against 6 *d.* which is lincked to it, likewise I take the difference between 3 *d.* and 4 *d.* which is 1, and set that against 5 *d.* which is lincked with 3 *d.* Again, I take the difference between 6 *d.* and 4 *d.* which is 2 *d.* and set that against 2 *d.* which is lincked with 6 *d.* And lastly, I take the difference between 5 *d.* and 4 *d.* which is 1, and place that against 3 *d.* which is lincked with 5 *d.* then I add all these differences together, and they make 6, which I place under them, and then the work will stand as is before expressed. Now for the working of this Question, or any other of the like nature, this is

THE RULE.

Multiply the Sum of the whole Mass to be made, by any of the particular differences, and divide that Product by the Sum of all the Differences, the Quotient shall be the just quantity of that particular kind, whose price standeth against that difference you multiplied with.

Example.

First, Multiply 50 ounces (the whole *Mass*) by 2, the difference which ſtands againſt 2 *d.*) and it makes 100, this divided by 6, (the ſum of all the differences) gives $16\frac{4}{6}$ for the number of ounces that muſt be taken of the price of 2 *d.*

Secondly, multiply 50 the whole *Mass*, by 1, the difference ſtanding againſt 3 *d.* it makes 50, which divide by 6, the ſum of the differences, it gives $8\frac{2}{6}$, and ſo many ounces muſt be taken of the price of 3 *d.*

Now ſeeing the differences ſtanding againſt 5 *d.* and 6 *d.* are 1 and 2, the ſame quantity of ounces as was taken for 3 *d.* muſt be taken alſo for 5 *d.* and the like quantity of that of 6 *d.* as was of 2 *d.* As by the work following will appear.

	Ounc.			Oun.	
6	50	2	6	50	1
	2				
	100		2	On.	d.
6	4 On.	d.	50	$8\frac{2}{6}$ of 3	
100	$16\frac{4}{6}$ of 2		6		
6					

By

By this work you may perceive that you must take 16 Ounces $\frac{4}{7}$ of the Spice of 2 *d.* the Ounce. And also that you must take 8 Ounces, $\frac{2}{7}$ of that of 3 *d.* And because the differences against 5 *d.* and 6 *d.* are the same with those against 2 *d.* and 3 *d.* therefore take $8\frac{2}{7}$ ounces of that of 5 *d.* and $16\frac{4}{7}$ ounces of that of 6 *d.* And these 4 four added together will make up 50 Ounces the required Masse, which may thus be easily proved, for,

Ounces		*d.*	
$16\frac{4}{7}$	}	2	}
$8\frac{2}{7}$	} of that of	3	} the Ounce
$8\frac{2}{7}$	}	5	}
$16\frac{4}{7}$	}	6	}

In all 50 Ounces

But here it is to be observed, that there was no necessity of lincking the numbers as they were before lincked, but may be varied at pleasure, for whereas before I lincked 2 and 6, and 3 and 5, I might have lincked 2 and 5, and 3 and 6. But by this diversity of lincking, there will follow a diversity of answer to the question, but both of them true, as may appear by the following Work.

Example.

Let the Numbers be linked as here you see, the common price set on the left hand, and the several Masse on the right hand, and the sum of the difference under them, then multiplying 50 by 1, the product is 50, which divided by 6, the quotient is $8\frac{2}{6}$ and so much must be taken of the price of 2 *d.* and the rest as by the following operation doth appear.

sum 6

	oun.	
6	50	1
(2		
5∞	(8⅔ of 2 *d.*	
6		

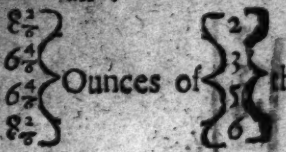
	oun.	
6	50	2
	2	
	100	
4(4		
∞∞	(16⅔ of 3 *d.*	
66		

	oun.	
6	50	2
4(4		
∞∞	(16⅔ of 5 *d.*	
66		

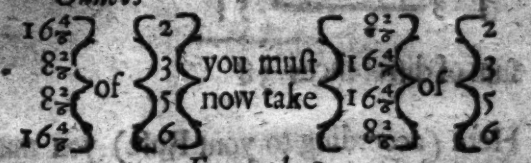
	oun.	
6	50	1
(2		
5∞	(8⅔ of 6 *d.*	
6		

The

The Numbers being lincked as here you must take.



In all 50 Ounces as before, But whereas before you took

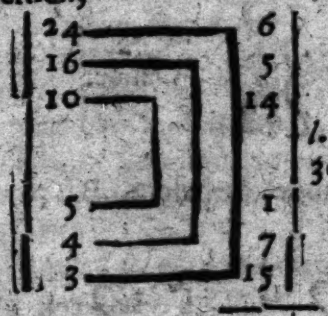


Example 2.

A *Founder* hath six sorts of Metals, of several prices, one at two shillings, another at one shilling four pence, a third at ten pence, a fourth at five pence, a fifth at four pence, and a sixth at three pence the pound; of these he would make a mixture of thirty pound weight, so that the price of each pound weight should be nine pence; how much must he take of each sort?

Having placed the Numbers and lincked them together, and their differences, and the sum of these differences, distinctly as hath been shewed before, and as may be seen by the Example following, the manner of per-

forming the work will be as in the former Queſtion,



ſum of differences 38

Here (according to your Rule) you muſt multiply 30 (the whole Maſſe to be made) by 6 (the firſt difference) the product is 180, which divide by 38 the ſum of all the differences, and the quotient will be $4\frac{8}{19}$, and ſo many Pounds muſt be taken of that ſort of Metal of 2 *s.* the Pound, as by the work appears and the like courſe muſt be taken for the reſt.

1 For that of 2 *s.* the Pound.

	lib.	
38	30	6
	6	
	180	

(2
6(8
180 (4 $\frac{28}{38}$ for that of 2 *s.*
38

2 For that of 1 *s.* 4 *d.*

	lib.	
38	30	5
	5	
	150	

(3
6(6
250 (3 $\frac{36}{38}$ for that of 1 *s.* 4 *d.*
38

3. For that of 10 *d.*

	lib.	
38	30	4
	4	
	120	

3(6
~~120~~ (3 $\frac{6}{38}$ for that of 10 *d.*
~~38~~

4. For that of 5 *d.*

	lib.	
38	30	1

0 $\frac{30}{38}$ for that of 5 *d.*

5. For that of 4 *d.*

	lib.	
38	30	7
	7	
	210	

6(2
2 x 8 (3 $\frac{20}{38}$ for that of 4 d.
38

6. For that of 3 d.

	lib.	
38	30	15
		30
		450

(3
4
x 7(2
450 (11 $\frac{32}{38}$
388
3

4.	28	These particular quotients being added together (the Denominators of the Fractions being omitted) as in the Margin, their sum is 26 *lib.* and $\frac{152}{38}$ of a *lib.* divide therefore 152 by 38, and the quotient will be 4, which add to 26 and it makes 30 *lib.* the whole Masse required.
3.	36	
3.	6	
0.	30	
5.	20	
11.	32	
26.	152	

The

The same Question resolved, the Numbers being otherwaies linked.

(I.)

38 30 4

4

120

3(6 d.

x.20 (3 5/11 for that of 24

38

(II.)

(II.)

38 30 5

5

150

(3

6(6 *d.*

150 (3$\frac{14}{19}$ for 10

38 (that of

(III.)

38 30 6

6

180

(2

6(8 *d.*

180 (4$\frac{21}{19}$ for 10

38 (that of

(IV.)

38 30 15

30

450

(3
~~4~~
~~17~~(2 d.
~~450~~ (11 $\frac{32}{38}$ for 5
~~388~~ (that of
~~3~~

(V.)

38 30 7
7

210

(2
~~6~~(0 d.
~~210~~ (5 $\frac{20}{38}$ for 4
~~38~~ (that of

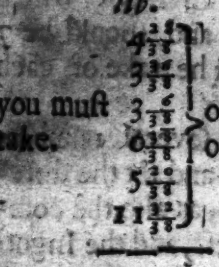
(VI.)

38 30 1 d.
c $\frac{30}{38}$ for that of 3

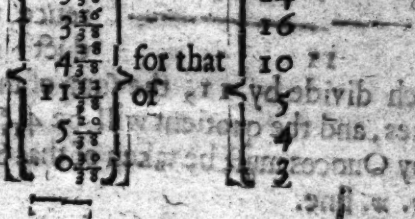
By

By the different linking of the numbers you may now see what difference ariseth in the quantities of the several sorts, for by the

First linking



Second linking.

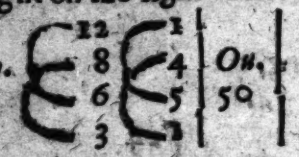


Question

Question 3.

A Goldsmith hath four sorts of Silver, one of 12 *p. w.* fine, another of 8 *p. w.* fine, a third of 6 *p. w.* fine, and a fourth of 3 *p. w.* fine, of these he would make an Ingot which should weigh 50 Ounces and should be 7 *p. w.* fine; how much must he take of each sort?

Having set down your several numbers and lincked them together, and set the differences and the sum of them, as also the common price of them on the left, and the Ingots weight on the right hand.



First multiply 50 the Ingots weight by 1 the first difference, the product is 50, which divide by 11, the sum of the differences, and the quotient will be $4\frac{6}{11}$, and so many Ounces must be taken of that Silver of 12 *p. w.* fine.

Do so for all the rest as you see done in the Example following.

	Oz.	
11	50	1
x(6		p.w.
50 (4 $\frac{6}{11}$	for	12
xx	(that of	

And seeing that the difference which stands against 3 *p. w.* fine is 1, you need not make it, but set down $4\frac{2}{11}$ Ounces for that also,

For 8 *p. w.* fine.

11	50	4
	4	
	200	
x		
x9(2		
x88	(18 $\frac{2}{11}$	for 8
xxx		(p.w.
x		

For

For 6 p. m. fine.

$4\frac{6}{11}$ 11 50 5
$18\frac{2}{11}$ 5
$22\frac{8}{11}$ 250
$4\frac{6}{11}$
x
50 3(8
250 (22 $\frac{8}{11}$ for that of 6 p. m.
xxx
x

These four Numbers $4\frac{6}{11}$, $18\frac{2}{11}$, $22\frac{8}{11}$, and $4\frac{6}{11}$ added together, make 50, equal to the Ingots weight, which was required.

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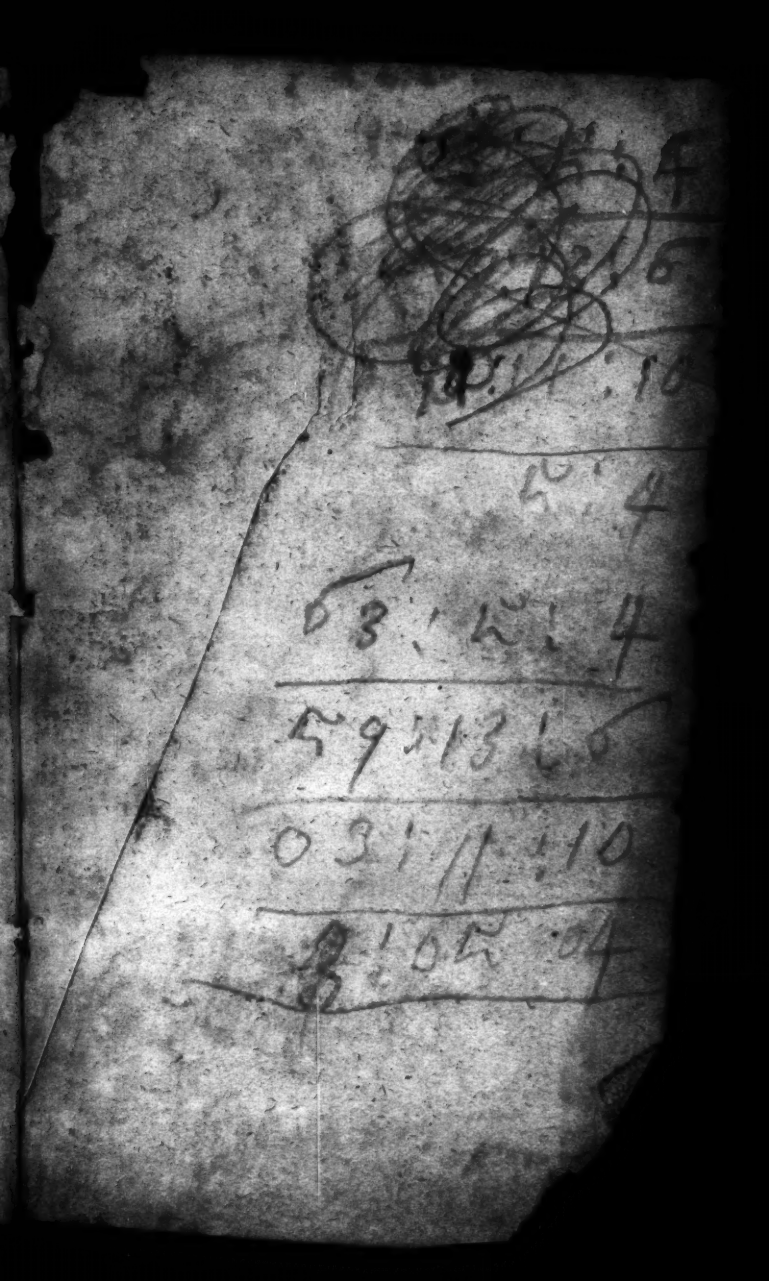

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